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Vol. VI | *Chicago* | NOVEMBER, 1910 | *New York* | No. 11

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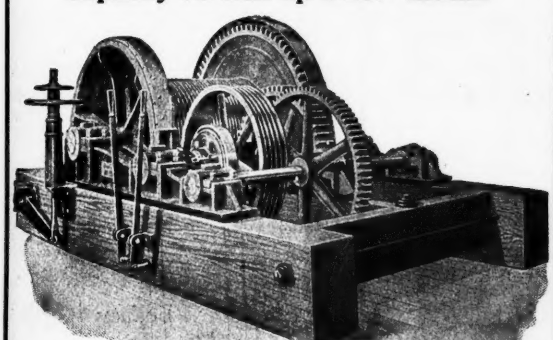

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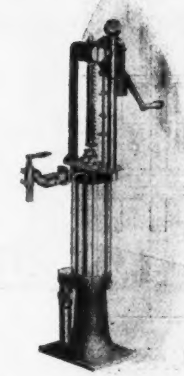

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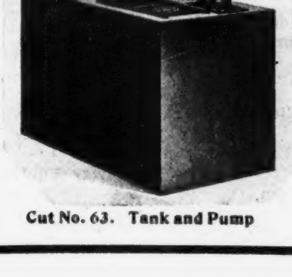

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RAILWAY
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BRIDGES—BUILDINGS—CONTRACTING—SIGNALING—TRACK
Published by THE RAILWAY LIST COMPANY

WILLIAM E. MAGRAW, Pres. and Treas.
CHAS. S MYERS, Vice-Pres. C. C. ZIMMERMAN, Bus. Mgr.
NORMAN F. REHM, Editor J. M. CROWE, Mgr. Central Dist.

Office of Publication: 315 Dearborn Street, Chicago
Telephone, Harrison 4948
Eastern Office: 50 Church Street, New York
Telephone, Cortlandt 5765
Central Office: 403 House Bldg, Pittsburg

A Monthly Railway Journal

Devoted to the interests of railway engineering, maintenance of way, bridges and buildings.
Communications on any topic suitable to our columns are solicited.
Subscription price, $1.00 a year; to foreign countries, $1.50, free of postage. Single copies, 10 cents. Advertising rates given on application to the office, by mail or in person.
In remitting, make all checks payable to the Railway List Company.
Papers should reach subscribers by tenth of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter April 13, 1905, at the Post Office at Chicago, Illinois, Under the Act of Congress of March 3, 1879.

Vol. VI. Chicago, November, 1910 No. 11

Contents

THE SIGNAL DEPARTMENT.

WE PUBLISH this month the standards of the C. M. & St. P. This company has lately gone into automatic block signaling on a rather extensive scale, it is, in fact one of the pioneers in this art in the West. Lately the upper quadrant, three position type of signal now so popular, has been adopted and some old work is being changed over to conform with the new standard, especially where new work overlaps old, as in carrying the automatic block system through interlocking plants. The circuits used, and methods of construction are very similar to those of the Rock Island, described in our issue of February. In the circuits, one notable difference is in the use of a small potash line battery instead of gravity, as used on the Rock Island.

On this road polarized line circuits are used on double track apparently throughout, whereas the Rock Island uses track. With modern relays, slot coils and pole changers, the them only on single track and in special cases on double track. With modern relays, slot coils and polecronzers, the polarized circuits are reasonably reliabie yet it seems rather strange to employ them where neutral circuits will cost no more, or perhaps less.

WINTER

WHAT IS THE most important work for the section forces in preparation for winter? This is the question which we addressed to a number of maintenance of way officers. The replies show that the one thing of importance above all others is drainage. Keep your track well drained and the frost will have very little chance to disturb it. Clean out the ditches in cuts, or dig new ditches, look to the walls of cuts where the earth is liable to slide and drain them in the best manner possible, look to road crossings and railway crossings, especially. Both the latter are constant trouble makers if not properly drained. One great mistake often made in caring for railway crossings is to dig a great hole under the frogs and fill in with stone ballast. The results may be good in warm weather, but in winter the large lump of ballast is only a trap to catch all the surface water and hold it under the roadbed as in a sponge so that when it freezes it expands and leaves the crossing out of line and grade. By all means lay farm tile under the crossing, if this is too expensive, long bundles of saplings or brush surrounded by cinders and stone in a trench connecting the lowest point of the ballast with some place to which the water can run. By this means many dollars may be saved in labor and material for repairs to the frogs and for surfacing track.

EFFECT OF FIRE ON CONCRETE.

WE PUBLISH below an item, which, though taken bodily from another paper, is of sufficient interest to warrant its appearance in this place. The item is self-explanatory:

A fire occurred in a building of reinforced concrete and brick. The original estimate of loss was made on the basis that the concrete floors and ceiling were not damaged sufficiently to be torn down. The owner refused to accept these figures, claiming that the concrete had been damaged and weakened. He requested that the building be tested by putting on a weight of 400 lbs. to the square foot, and if the flooring deflected more than $\frac{3}{16}$ in. it was defective and would have to be removed. This was the original test made by the architects when building was completed and turned over to the owner.

A panel 14½ ft. x 18½ ft. in the northeast corner of the building was first tested, and when a weight of 250 lbs. to the square foot was put on the floor deflected $\frac{5}{16}$ in. Another panel was tested and a deflection of ¼ in. to 250 lbs. was noted. There were eight panels, all approximately 14½ ft. x 18½ ft., which were involved in the fire, and as a further test it was decided to try one panel in another part of the building which had not been damaged by the fire, in order to see how it would show up. The sand used for testing was therefore removed to this panel, and with the same weights, viz., 250 lbs. to the square foot, this panel did not deflect over $\frac{3}{32}$ in.

The test seems to demonstrate the virtues as well as the defects of concrete construction. As there were about 60,000 lbs. of powdered drugs burned, a tremendous heat was created which would have meant a total loss to the building had it been of any other construction. At the same time, there is indicated by these tests a defect in concrete which it may be impossible to overcome, and that is, that the reinforcing steel used in its construction undoubtedly expands under a certain heat, causing the concrete to weaken.—*National Fire Protection Association Quarterly.*

Wood Preservation From an Engineering Standpoint

C. T. Barnum—U. S. Forest Service.*

For a number of years engineering throughout the country have been confronted with the fact that the supply of timber for structural purposes is being rapidly exhausted, and they have been compelled to give serious consideration both to conserving the present supply and to developing other materials to act as substitutes.

That much energy and though has been given to the substitution of other materials for wood is evident when we consider what has been accomplished. In this work the use of steel and concrete, both separately and in combination, has undoubtedly far exceeded that of all other materials. The vast quantity of reinforced concrete now used for all kinds of buildings and construction purposes, the amount of steel used for towers and poles in electric transmission lines, the number of steel and concrete bridges, and the growing popularity of steel for the construction of railroad cars, indicate only a few of the many ways in which these materials have been successfully utilized. Experiments are being carried on continually to extend these uses, and there is every reason to believe that much more will be accomplished. The effect of this substitution on the growing demand for structural timber is enormous, but in spite of this successful substitution the demand for wood as a structural material has steadily increased from year to year. In illustration of this increasing demand for timber, the Forest Service estimates show that the lumber cut of the United States increased from eighteen billion board feet in 1880, to forty billion board feet in 1907. In view of these figures it is safe to assume that it will be a very long time before we find ourselves able to do without it.

There is another factor to be considered in the substitution of inorganic materials for wood. The limited supply of these materials must be keep in mind. Iron, for example, once taken from the mine is gone and cannot be renewed. Wood, on the other hand, is capable of growth and hence of indefinite replenishment from the same area. This fact will cause metals especially to rise in value, so that the ratio of cost between them and wood for construction purposes is a sliding and ever-changing one.

It is to be regretted that the energy which has been devoted to conserving our wood supply has not been equally as strong as that devoted to finding wood substitutes. Why it has not met with the same consideration is hard to determine, but the fact remains that in view of its importance only indifferent attention has been given to it. For certain classes of construction wood is, on account of its inherent properties, best adapted for use, and it has so far resisted all attempts to displace it.

For railroad ties, telephone and telegraph poles, piling, mine props, and structural lumber, wood has shown its superiority. The extensive use of other materials for these purposes, of course, cannot be overlooked. Steel and concrete railroad ties, reinforced concrete and glass poles, steel and concrete piles and mine props are instances of this. In 1907, 572,233 steel ties were sold by one company. This company claims that the steel tie is no longer an experiment. Very much the same progress has been made with other forms. Reports from various users of this material, however, show that uncertainty of successful substitution still exits and the general impression throughout the country is that considerable more experimenting must be done before satisfactory substitution is accomplished.

This brings us back to the consideration of our timber supply for use in these particular cases, and when we consider the amount of wood consumed here, its importance is seen to be justified. Census statistics shows that in 1907 the steam and electric railroads of the country purchased some 153,000,000 cross ties, the telephone, telegraph, and other electric companies purchased over 3,500,000 poles, and it is estimated that throughout the mines in this country over 170,000,000 cubic feet of round mine timber was used. There are no reliable figures to show the production of timbers intended for use in the construction of bridges and for use in piling, but it is estimated that for the latter at least 2,000,000,000 feet were used. When we consider that these products constitute less than one-fifth of the total volume of lumber cut, we get some idea of the enormous drain on our timber resources. It is further estimated by the Forest Service that the rate of cutting at the present day is exhausting our resources at the rate of about three times their growth. It is quite evident, therefore, that unless some radical changes be made a serious shortage of structural timbers is inevitable. This is especially true of the harder and more durable woods. The supply of this better grade of timber, which through its own properties resists decay for a reasonable time, is rapidly waning and in consequence its price in the market is rising. The average price of white oak, for instance, increased at the mill from $13.78 per thousand feet in 1900 to $21.23 per thousand feet in 1907, or 59 per cent. Leading lumber dealers, railroad managers, mine superintendents, and other consumers of timber for structural purposes, are accordingly turning their attetnion to ways and means of substituting cheaper and more plentiful kinds of timber for the better and more durable grades. Thus, where specifications once rigidly insisted upon first quality white oak for ties, or heart longleaf pine for dimension stuff, they are now given a very liberal interpretation, and other species than white oak are accepted with no difference in price, or considerable amounts of sapwood are allowed on "all-heart sticks."

This deterioration in quality naturally results in a decreased length of life, which in turn compels a large annual cut of timber.

Treatment.

A feasible and effective way of relieving the situation is by the treatment of the timber to protect against decay. A successful treatment of this sort, provided the cost can be kept within economical limits, will, in the long run, not only greatly decrease the cost to the consumer, but will also tend to decrease the annual demands on the forest. A proper preservative treatment will prolong the life of decay-resisting species as well as those of an inferior grade. If all ties, poles, posts, piling, mine props, shingles, and structural lumber adapted to treatment were given an efficient preservative treatment, an estimated annual saving of five million board feet would ensue. The practice of preservative treatment will also create a new and increasing market for many timbers not formerly used, and timber consumers will more easily break away from their former custom of adhering closely to a few well-known kinds and disregarding others which may be equally good in other respects but lack durability. Moreover, there will be an increasing realization that by the use of cheaper woods properly treated with preservatives, as good or better results can be obtained, together with the reduction of the annual cost. This last item, the saving in dollars and cents, is the all-important factor of wood preservation. As soon as the consumer fully understands that his annual expenses can be actually reduced by these methods, it is only natural to conclude that a strong effort will be made for their adoption.

Wood preservation is an exceedingly complex subject, and upon considering it many problems arise for solutions. There has been a great deal of thought given to it, and it has undoubtedly made rapid strides during the comparatively short time it has been practiced in this country. Nevertheless, it

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*Read before the Western Society of Engineers.

is still far from being on a sound scientific basis. The experiments that have been made show very clearly that each different species of wood, and wood of the same species but differing in the character of growth, present an entirely different set of problems. They differ greatly in the receptibility of different preservatives and they differ in the kind of preparation necessary for treatment and in their action in contact with the preservative, and after. The kind and condition of wood to be treated and the conditions under which it is to be used are very important factors in determining the kind of treatment that is best. The effect of the preparation and of the preservative on the mechanical properties of the wood are also very important, and must be carefully considered before any treatment is decided upon. Present practices are now largely determined by the experience derived from preceding years rather than an intimate knowledge of the theory of the subject. This latter feature, however, is most important and is at the present time receiving much deserved consideration. The Forest Service in its laboratory now being erected at Madison, Wis., expects to study very comprehensively the different theoretical questions arising in this work, and it is hoped that this will result in extending our knowledge of the action of different preservatives and the way they should be applied to each species of timber to secure the best results.

During the early period of wood preservation in this country, the expense of the treatment and the necessary apparatus and the lack of reliable information regarding the results prevented to a great extent its extensive adoption. As the demand for it increased and more reliable figures were obtained regarding the actual increase in life from various treatments, the economic results were better understood. This led to a larger development, and at the present time there are over sixty wood preserving plants operating in the United States, with an output, in 1907, of one and one-fourth billion feet.

Preservatives.

Of the many antiseptics which at one time or another have been proposed for the preservation of timber, two different classes may be made: (1) Antiseptic salts and various substances, such as zinc chloride, corrosive sublimate, and copper sulphate; and (2) antiseptic oils, of which creosote, or dead oil of coal tar, is most generally used. The most common preservatives in general use are zinc chloride and creosote, and both are excellent antiseptics. It may be said, however, that the principal value of zinc chloride is its cheapness and its ease of transportation, for it can be hauled in the form of a solid and dissolved at the treating plant. The principal defect of zinc chloride is its liability to reach out of the timber when exposed to moisture either in the soil or in the atmosphere. It readily dissolves in water and so its subsequent leaching out is merely a question of time, and the wood is left once more subject to attack. Its use, therefore, is limited to less moist situations. Creosote, on the other hand, is practically insoluble in water, so when a high grade of oil is used and injected into the timber, decay will be postponed almost indefinitely. Its principal disadvantages are its higher first cost as compared with zinc chloride, and its limited supply and the subsequent difficulty in getting a good grade. In treatments for many structural purposes, such as piling and timber in wet situations, and especially where a long life is desired, creosote undoubtedly has demonstrated its ability to give the best results. Upon examination of certain timbers that have resisted decay for a long time, it has been learned that it is the heavier constituents of the oil that have remained in the wood, and it is therefore concluded that these constituents are to be depended upon in preservation work. For this reason, it is considered advisable that when specifying for creosote the heavier fractions should be called for.

Treating Processes.

Treating processes as practiced to-day may be divided into two general classes: those which use pressure, and those which treat without pressure. Both of these may be subdivided into what is known as full cell and empty cell processes. The pressure process is too general and too well known to need description here. It is the more widely used of the two and without doubt the more effective for work on a large scale, and where a variety of woods must be treated. Pressures above 175 lbs. per sq. in. are seldom exceeded in these plants, as with proper preparation practically all woods can be treated with this pressure, and for many woods less is needed. The quantity of treated wood required determines the volume and size of the apparatus used and its cost. A plant of this kind having a capacity of about 3,000 ties per day would cost about $40,000 to install. Within the last year or so there has been introduced a plant in which only a medium amount of pressure is used. This type may be called a medium pressure plant. In it pressures ranging from 50 to 100 lbs. per sq. in. are used. It is principally adapted for use by mining companies or city traction companies, where woods of a porous nature not especially resistant to the entrance of the preservative are used. Such a plant would usually be of a much less capacity than the ordinary plants, on account of being designed for the treatment of special classes of timber for local use, and can be built more cheaply on account of being of lighter construction. A plant of this type, with a capacity of 1,500 ties per day, would cost, approximately, $20,000 to install.

Plants which treat without pressure are rightly called non-pressure plants. This type of plant is not the open-tank proper like that used in the treatment of butt telephone poles, but a closed cylinder similar to those of the pressure and medium pressure plants, but made of very much lighter material, usually ¼-inch iron. The Forest Service has done much to develop this latter plant, because this process has filled a real need, a need which the pressure process could not fill. The development of this non-pressure process is due very largely to the heavy expense involved in the purchase and installation of the pressure plant, an expense which confines such plants to large commercial companies or to companies such as railroads, which demand a very large and fairly constant supply of structural timber, comparatively resistant to the entrance of the preservative. It is not to be understood that this non-pressure process is to replace in any manner the older and more firmly established pressure processes for all timbers and conditions.

What was needed was a process by which the more porous lumber of different kinds and for different conditions could be treated efficiently and cheaply in a plant inexpensive to install and simple to operate. The record of attempts to meet this need is the history of the non-pressure process. This type of plant generally has a treating cylinder 6 feet in diameter and about 50 to 60 feet long, and a capacity of about 500 ties per day. It may be completely installed for from six to eight thousand dollars.

For the butt treatment of telephone and telegraph poles an ordinary open tank, either rectangular or round, about 9 feet in diameter by 9 feet deep, and fitted with steam coils, is used. A storage tank of small capacity for holding a supply of the preservative, and a jib crane for handling the poles in and out of the treating tank, complete the equipment. Such a plant can be installed for eight or ten hundred dollars.

A full cell treatment or process occurs when the wood cells and intercellular spaces of the timber are completely filled with the preservative. The portion of the timber treated in this case is made to take as much of the preservative as the cells are capable of containing. On account of

the expense involved in a treatment of this kind, with a preservative as costly as creosote, means have been sought to remove from the timber a portion of the preservative injected. In this manner the same penetration is secured with a much less amount of the preserative, and the cost of the treatment is consequently decreased. In treatments of this kind the preservative contained in the cells proper is withdrawn, and the cell walls left simply coated or painted with the preservative. This process is used largely in treating railroad ties with creosote, where mechanical wear destroys them before the increased life to be derived from a full cell treatment can be obtained.

Length of Life.

The length of life of treated timber, like the treatment, depends on a variety of conditions. The kind of wood, kind of preservative used, the kind of treatment given, and the conditions under which the treated timber is used, all have an important bearing on the length of life. In the southern states, Louisiana and Texas particularly, a loblolly pine tie untreated will last little more than a year. Ties treated with zinc chloride and placed in a track in the same locality have been removed in three years on account of decay. The life of the same species of timber in one section of the country will not be the same when exposed to the climatic conditions in another section. The use of zinc chloride as a preservative does not give as long life as creosote. Ties properly treated with this can, however, be made to give an average life of about 12 years. In the Central West, hemlock and tamarack ties treated by the Wellhouse process have shown a life of 12 to 14 years, while untreated ties under the same conditions have to be removed at the end of four years on account of decay. Properly creosoted ties can be made to last until destroyed by mechanical wear, and if protected against this wear can be made to give 20 to 30 years' service. With the proper kind of treatment, a pile can be made to last from 20 to 25 years. The L. & N. R. R. in 1882 used large quantities of creosoted piles, stringers, and caps in the construction of trestles and docks in the vicinity of Pensacola, Fla. All of this material gave a service of over 25 years. The New Orleans & North Eastern Railway bridge across Lake Pontchartrain is another notable example of the efficient service to be expected from a good treatment. This bridge was built in 1876 on creosoted piling, most of which to-day is in a good state of preservation. Most of the timber used in these instances was southern pine which, if untreated, would be destroyed by marine borers in three years or less. At Girardville, Pa., in the Reading Coal Company's mine, treated timbers have given 12 years' service where ordinarily they would be removed in two years.

The Forest Service has estimated that proper preservative treatment will increase the life of ties over 200 per cent, poles 100 per cent, posts 300 per cent, piles 700 per cent, mine props 400 per cent, and lumber 300 per cent. These figures are made up of the average estimates of treated and untreated life for the various forms all through the country and under all conditions, so they naturally give merely an indication of the results of treatment which, in specific instances, may be much more or less than the general average.

Economic Considerations.

It has been clearly demonstrated that the life of timber in many situations has been increased at least two-fold by the use of preservatives and often the increased life is very much greater. Suppose, for example, that certain timbers put to a certain use will last five years without treatment. Disregarding interest charges, it is therefore true that the cost of treatment must be less than the additional cost of new timbers five years later, plus the cost of their setting in order to effect a saving. In treating on a large scale the additional cost of any treatment now practiced does not usually exceed the present purchase price of the timber. Therefore, the saving means at the least the cost of resetting the timbers, plus the advance in price of the timber, over a period of five years. For example, the popular grade of mine timber in the West has increased some 40 to 50 per cent in price within the last five years, and it is reasonable to suppose that a corresponding, if not greater, increase will occur within the next five years. Therefore, the financial saving from a treatment, which will double the life of the timber, will be equal to the cost of replacement, naturally a variable quantity, plus 50 per cent of the present cost of timber. More frequently a good treatment will triple and quadruple the life, and the financial saving is correspondingly greater. Another factor entering into the economic value of the treatment is that often replacement of timber is an expensive undertaking. It means in some cases a shutting down of work on hand during the period of replacement, with the consequent more or less serious financial loss. For instance, the replacement of the timber in a mine shaft will often partially, if not wholly, stop all the work through that section during the period of replacement, with a corresponding financial loss to the company. Since by treatment these replacements may be easily reduced by one-half and oftener to a greater extent, it can be seen that this element bears an important relation to the financial saving growing out of preservative treatments.

With railroad ties a wide field for the betterment of conditions exists in the more general introduction of preservative treatment. Formerly, white oak was the most popular and widely used species for this purpose, but in the past 10 years the cost of the oak tie has more than doubled, and railroads have consequently been turning their attention to other species. Thus loblolly and shortleaf pine in the South, hemlock and tamarack in the Lake states, lodgepole pine and engelman spruce in the West, birch in Wisconsin and the New England region, and maple and beech in Michigan, Pennsylvania, New York and Vermont, are gradually attaining recognition and rarely fail, when properly protected from decay and mechanical wear, to give satisfactory results. For example, it has been estimated by the Chicago & Northwestern Railway that the cost of the average untreated hemlock or tamarack cross-tie, when laid for use west of the Mississippi, is 75 cents. The cost of a satisfactory impregnation with zinc chloride is about 12 cents per tie, making the cost of the treated tie 87 cents.

The annual charge on an untreated tie costing 75 cents is 16.8 cents. For a treated tie costing 87 cents and lasting 6 years, the annual charge is 16.6 cents; lasting 7 years, 14.5 cents; lasting 8 years, 12.8 cents; and 10 years, the estimated life of a treated tie, is 10.7 cents. These figures demonstrate that an added life of a single year makes the cost of treatment practicable and an added life of five years (a conservative estimate) secures a saving of 36.3 per cent in the annual charge. By the substitution of a creosote for the zinc chloride treatment, although somewhat increasing the initial cost, the tie can be conservatively counted upon to resist decay for 18 years, and this added length of life will amply repay the extra cost of the treatment.

By proper preservative treatment and the prevailing rates of interest, it can be conservatively estimated that the net annual saving for each form treated would be about 3 cents for a tie, 9 cents for a pole, 1 cent for a post, 2 cents for a mine prop, and about 50 cents per thousand feet for lumber. This would result in a total annual saving of about $71,780,000. This includes the cost of labor as well as that of the timber itself, and this represents the amount of money that could be turned each year into other channels if wood preservation were uniformly adopted throughout the United States. It must be remembered, of course, that these figures

are made up of average estimates of untreated and treated life, and naturally cannot be applied to specific cases.

Wood preservation, then, accomplishes three great economic objects: (1) It prolongs the life of durable species in use; (2) it prolongs the life of inferior and cheaper woods and thus enables the utilization of those inferior woods which, without preservative treatment, would have little or no value; and (3) it reduces the annual charge and renewal charges whenever it is used, enabling the money saved to be put to other uses.

Discussion.

The President: The establishment by the Forest Service of a laboratory for testing processes and materials for wood preservation is certainly an important step in the art. So far, such experimental work has been carried on by different interests in various parts of the country and the results have often been limited by lack of resources. It will certainly be a great privilege to be able to call on a central experimental plant, where efficient apparatus has been installed, and where all kinds of preservative materials and woods are available for use. Of course it is too early now to speak of the results; these will depend on the way the station is operated and largely, as Mr. Barnum has said, on the co-operation of engineers and users of timber generally.

Several papers have been presented before this society in the past on the subject of wood preservation. The first one was by Mr. Samuel M. Rowe, in 1899, and Mr. Octave Chanute presented one in 1900. Mr. Chanute is with us this evening, and I am sure we shall be very much pleased to have him open the discussion.

Octave Chanute: After an experience of some 24 years in the preservation of wood, I will say that results depend largely upon the thoroughness with which the work is done. When we began work along this line the results obtained were not nearly as good as those we are obtaining to-day, simply because we had not had the necessary experience. We followed at time the German practice of injecting about one-third of a pound of chloride of zinc to the cubic foot of timber, and an average life of 11½ years was obtained with hemlock and tamarack ties. Since then we have ascertained that the Germans, in their extended experience, have increased the dose to one-half pound of dry chloride of zinc to the cubic foot, and with that we are now obtaining results (only 10 years old, however) which promise a life of 14 to 17 years in the track.

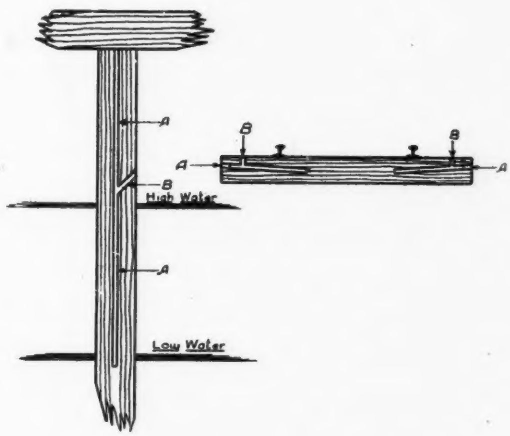
We also found that in the early days we treated the ties too soon, and did not allow them to be sufficiently seasoned to become entirely saturated throughout with the antiseptic treatment. I feel confident now, with the knowledge we have acquired, that we are going to get results with zinc-treated ties which will compare favorably with, although they will not equal, the results to be obtained with creosote. If creosote be thoroughly injected into wood with the full-cell process, the results which have been obtained in Europe show that a life of 20 to 27 years can be obtained. But there is one element there which does not obtain this country. The rolling stock on the European railroads is light; the weight per wheel is limited to about 10,000 pounds, while the weight of our modern freight cars is much greater, for instance, a car weighing 49,000 pounds and carrying 100,000 pounds will give wheel pressures of about 18,000 pounds per wheel. Those weights are all producing mechanical wear, so that the ties, whether treated with zinc chloride or creosote, are going to be destroyed by mechanical wear sooner than by decay. Therefore, the problem of preservation also brings up the problem of better track, which I hope will be given due attention by the engineers of railroads.

D. W. Roper: With regard to wood preservatives of various kinds, I would inquire if any of the preservatives mentioned have any active chemical properties which might injure metals which come in contact with the preservative?

Mr. Barnum: As to action of preservatives on iron and steel, creosote has no action that I know of. It does not cause deterioration in the iron cylinders or iron tanks in which it is used. Zinc chloride does; there is present in this solution a certain amount of free hydrochloric acid, and it is this that attacks the iron in the treating cylinders and tanks. The action is more severe on wrought iron than on cast iron; it will eat through a ¼-in. tank in 7 or 8 years.

Mr. Roper: Would that occur with railroad spikes?

Mr. Barnum: I have never heard what action zinc chloride solutions have in that connection. It might weaken the spike, but I do not know of any instance where this has occurred.



Mr. Chanute: If any of those present are thinking of trying to prevent the action of hydrochloric acid, I will say that the simplest thing is to keep in the storage tank a slab of zinc so as to take up every particle of free acid. We have practiced that method continually, with the result that we have on hand a venerable cylinder, which is now 20 years old—not much good, I will admit, but still it can be used—and our cars last from 7 to 8 years. We have had more trouble from the use of the peculiar grade of creosote which we have imported from Germany, which contains 25 per cent of tar-acids, and which has eaten the iron more rapidly than the zinc chloride.

W. W. Curtis: With reference to the hydrochloric acid in properly made chloride of zinc, there is no free acid. I have tested for it a number of times without having found it.

As to the action of zinc chloride on metal, I think it is due to the fact that the zinc chloride is a deliquescent salt and tends to maintain a condition of moisture in the wood, which may have some effect on spikes. But so far as the effect on the storage tanks is concerned, I think we may consider that there is none. I have used steel storage tanks with zinc chloride of 60 per cent strength, and if the tanks are given any kind of care at all, one can figure on their lasting for 10 or 12 years. There is a deterioration of the cylinders and of the cars in plants using zinc chloride, but in my judgment it is not the result of action of any acid, but of the atmosphere, acting on a surface, which is alternately wet and dry. A cylinder is subjected perhaps three times a day to steam, then to a solution, and then to air, and there is that same condition in connection with the cars, with the consequence that they rust. To my best knowledge this action is from oxidation and not from the effects of acid.

I have been interested in listening to the paper this evening, but the author is more enthusiastic than I have ever felt it safe to be. The conditions surrounding the life of treated timber are so variable, and the life is so modified

by those conditions, that it is difficult to speak positively as to results.

I used to say, years ago, when it was more difficult to convince people than it is now, that one could rest perfectly secure in the proposition that he would secure as long a life wtih ties made from inferior wood, treated with zinc chloride, as he would from white oak ties untreated. That statement was sufficient, in my judgment, to justify any and every railroad company in adopting treated timber, and it was a conservative statement. At this time there is not much difficulty in convincing railroad companies that it is desirable to treat timber—particularly railroad ties. There has been a wonderful change in thought along these lines in the last few years.

The results of some of my investigations made about 12 years ago indicated that up to that time there had been treated in this country, all together, less than 10,000,000 ties. Since then, plants that I have built myself have treated nearly that many ties in one year. I have not seen the statement of statistics, but should be very much surprised if 15,000,000 ties were not treated last year in this country.

The Forest Service has been doing very good and valuable work, but I am free to confess that I think they did better service three to five years ago than they have within the last two years. Many problems in the treatment of timber have been solved, but there are many still unsolved. The department in past years has devoted its energy largely to attempting to solve such problems as the determination of the length of time the ties should season before treatment; the relative amount of the salt solutions which could be injected with varying lengths of seasoning, etc., but it seems to me the Forest Service, in the last two years, has forgotten the purpose of its vocation, has gone outside of its sphere, and is becoming a commercial organization, rather than a scientific one as it was originally designed to be.

My attention was called, last spring, to a plant built in southern Ohio, described in a paper by one of the employes of the Forest Service, which he said was designed and built by the Forest Service. Shortly after that my attention was called to a letter received by a railroad official from an officer of the Forest Service, soliciting business for a timber-treating plant which it was announced the Forest Service had decided to build in Montana, the idea being to treat ties for the railroad company; or, if the railroad company preferred to build its own plant, the Forest Service offered to furnish plans and specifications, and all information and instruction, gratis.

There are a few engineers in this country who have attempted to develop a business along the lines of timber preservation, and it seemed to me somewhat incongruous for such men to compete with the United States government. Finally I wrote to Secretary Wilson and called his attention to these facts. I told him that when I began my investigations 12 years ago in connection with this matter I had hoped to have something to do with the development of the business; that the department of Agriculture was doing absolutely nothing in this line at that time, and it was some years after that before they actually took up the matter; that they had done good work in the way of reports which had been written and which contained a great deal of valuable information, but that that was some years ago. I asked him whether conditions had reached the state where professional men must compete with the government. Mr. Wilson said I was entirely right; that it was not the province of the government to compete with engineers or anyone else, and that the only reason that the department had taken up the matter was because, at the time they had done so, no one had succeeded in showing that soft-wood ties could be treated successfully so as to preserve them from decay. I then wrote Mr. Wilson that it was well known how to treat a soft-wood tie, but that what we did not know was how properly to treat a hard-wood tie. Shortly after that I received a pleasant letter from Mr. Hall, Assistant Forester, repeating the statement that the department had no desire to compete with the engineers, and that it was only in special conditions they were assisting in the construction of plants. I asked him for what reasons the proposed plant was considered desirable in Montana; also for what reasons the plant had been designed and built for southern Ohio, but the answer was not satisfactory.

My attention was called recently to a paper which had been received by one of the railroad companies in Chicago, entitled "Suggestions for Treating Railroad Ties with Wood Preservatives for Railroads in Eastern and Central States," dated June, 1909. There are some remarkable statements in the paper, and I wrote to Mr. Hall and asked whether it had received the approval of the department. His reply was to the effect that they were unable to identify the paper, and asked if I would send a copy to him. I was rather surprised that they did not recognize their own child. As yet I have not been informed that the paper has been disowned.

The report is in most respects reasonably accurate; it describes the various classes of timber that can be treated; it gives in great detail the cost of treatment and resulting life both of the untreated and the treated ties; it gives a description of the various classes of treatment, etc. Then I found something which rather surprised me. (It might be well for me to state here that I have no interest in any process of creosoting ties.) I found in that paper a description of the empty-cell process. The empty-cell process as ordinarily understood is represented by two patented methods—the Rueping and the Lowry.

The Congress of the United States, in 1790, concluded that it was wise to adopt a patent system in this country, and some people have endeavored to show that our prosperity has been largely based upon the monopoly for a term of years, secured to inventors by that law, which has been amended several times, but never repealed.

I will read a paragraph which I found in the "Suggestions":

"The empty-cell processes at present most generally practiced—namely, the Rueping and the Lowry—are patented. For their use a royalty is charged—2 cents a tie for the former and what amounts to from 6 to 9 cents for the latter. It is probable that the payment of these royalties is unnecessary. For the treatment of 750,000 annually, they would amount to $15,000 for the Rueping and at least $45,000 for the Lowry treatment. The Forest Service has had experience in devising methods of empty-cell treatment, and the results obtained strongly indicate the possibility of devising practical empty-cell processes which will not infringe on existing patents. For instance, two years ago a member of the service devised an empty-cell treatment for cross-arms. By the introduction of a preliminary vacuum, a small technicality, the method of treatment was made distinct from a patented process. Again, an empty-cell treatment has been worked out for treating mine timbers which is based on a non-pressure process. Briefly, in the opinion of the Forest Service, it would not be good policy for the company to adopt a patented empty-cell process without a most careful consideration."

That is, by the way, a misstatement of fact. The 6 to 9 cents mentioned includes not only the royalty but a profit on the construction and operation of the plant. "It is probable that the payment of those royalties is unnecessary." It seems to me a little out of place for one department of the government to use the public funds to try to undermine a system established by another and superior branch of the government. I do not know whether the Forest Service will

have the patent laws repealed by the next Congress or not; probably it will.

I find in this report also:

"Ties of some porous wood, such as loblolly pine and black gum, can be treated effectively in a plant of comparatively light and inexpensive construction, equipped for the application of a low pressure (70 pounds). The Forest Service has designed such a plant for the Indianapolis, Columbus & Southern Traction Co., of Columbus, Ind., and the Tennessee Coal, Iron & Railroad Co., of Birmingham, Ala. A plant of the same general type but of heavier construction has been designed for the Great Southern Lumber Co., of Bogalusa, La. The capacity and estimated cost of these plants is as follows:

	Annual capacity	Maximum pressure	Estimated cost
(1) I. C. & S. T. Co.	180,000 ties	70 lbs.	$ 6,000
(2) T. C. I. & R. R. Co.	300,000 ties	70 lbs.	15,000
(3) G. S. L. Co.	450,000 ties	100 lbs.	25,000

"Blue prints of plants 1 and 3 are included in this report. It is clear that a low-pressure plant is much less costly than one equipped for high pressure. Moreover, the former type of plant is less expensive to maintain and operate and is suitable for the application of a full-cell or empty-cell treatment."

I was rather amused, in the light of Mr. Hall's letter to me of last April (in which he said that the department was not attempting to compete with private individuals), to find that 60 days later he was offering to furnish free plans and specifications for another plant; and also the services of an assistant to superintend the erection of the plant and instruct the parties in the operation thereof, for the munificent sum of $75 per month. I am sure that people who want that class of service are welcome to it. I think the department has gone outside of its sphere when it undertakes to furnish plans, specifications and superintendence on such work.

Mr. Wilson, in his letter to me, suggested that he was entirely willing to stop all work in these lines whenever it was demonstrated that private interests would take it up. I replied that we did not want the Forest Service to stop its work, for there is a tremendous amount of investigation and experimental work that needs to be done in timber preservation, and which only the government has the time and money to do. Let the Forest Service do this and leave the design and construction of plants to the individual. If there were not men in this country who were familiar with the construction and operation of timber-treating plants, I would most heartily say to the Forest Service, "Go ahead!" But it is a curious fact, notwithstanding all the effort that the department has put forth, it has not yet proposed one single improvement in a timber-treating plant. It has exploited the non-pressure method, which is good for an extraordinary situation and nowhere else; but this is not a new process by any means. There has not been a single improvement made in the treating of timber which has been originally recommended by the government.

Theodore Kandeler: It has been said that the antiseptic fluid leaches out of the timber when used in wet places. Has it ever been tried to replace the preservative fluid by means of holes in the timber to contain a fresh supply?

(To be continued)

In a fire at East St. Louis on October 20 the freight house of the Chicago & Alton, together with other buildings adjoining, was completely destroyed; total loss estimated at $500,000. The flames were spread by the explosion of ten tank cars filled with oil, making the fire uncontrollable for a considerable time. There was also a large loss at the Baltimore & Ohio freight house.

The payment of pensions undoubtedly tends materially to enhance safety by promoting contentment among the employees. By fostering the feeling on the part of the employee that he has a permanent interest in the company's welfare, good discipline is promoted. There is probably no one factor so important to the safety of railroad operation in this country at the present time as the promotion of good discipline among employees. Excellent results have manifested themselves from the operation of the pension system on the Pennsylvania and on the Baltimore & Ohio, and the board notes with satisfaction that the companies embraced in the "New York Central Lines" have recently decided to pay pensions to their employees.

The reasons why the use of the block system should be enforced by law have been set forth in previous reports, and scarcely need repeating. Progress is being made by a number of important roads, but that progress is very irregular. In some cases the block system has been abandoned. A principal feature of the bill which has been before Congress is the provision for governmental supervision of the operation of the block system. Only by such comprehensive supervision will it be possibly adequately to deal with the defects in manual block signaling which have been pointed out in this report, or to secure the full information which the public should have, concerning manual block signaling, automatic block signaling, interlocking of switches and signals and train operation generally.

From Report of Block Signal and Train Control Board.

Precautions Against Fire at Pennsylvania Station.

A firewall stretching across Manhattan island from Ninth to Seventh avenues has been completed by the construction of the Pennsylvania station and adjacent buildings. The full fire protection system of the station has just been put into operation and insurance engineers say a conflagration such as was experienced in Baltimore and San Francisco is now an impossibility in that part of Manhattan.

The Pennsylvania station covers over 28 acres, with three levels below the main floor, the lowest being 36 ft. below the street line. About three miles of piping, weighing 425 tons, was used, and there are 117 hose connections, 24 roof hydrants and 12 flush hydrants. The plans provide for maintaining 12 standard fire streams, or 3,000 gallons a minute. There are two 1,500-gal. Blake pumps in addition to the 16-in. suction from two storage tanks, having a total capacity of 75,000 gals. The pumps and tanks are in the station service plant, a separate building on the south side of 31st street. The supply pipes throughout are carried in pipe subways which encircle the entire station area. The pipes are carried on transverse cast iron hangers supported from steel girders, readily accessible for inspection or repairs.

In the track level area there are 23 hose connections on train platforms and 12 fire hydrants in the yard west of the station building. Hand chemical extinguishers have been provided in the corridors of the upper floors and at other points throughout the station, comprising in all 75 three-gallon extinguishers. In addition, there will be 33 extinguishers of the non-freezing type placed in column recesses on the track level floor, where freezing conditions may exist. For the station building there will be in addition to the equipment specified a 500-ft. reel hose carriage and a 60-gal. chemical engine. The total equipment of 2½-in. fire hose for the station exceeds 15,000 ft.

A complete closed circuit fire alarm system covers the entire station and service plant. There are in all 20 boxes of the non-interfering successive type, wired in loops of 10 stations each, recording on three gongs, located under main concourse, yardmaster's office and station service plant.

The Maintenance of Way Department

Editor Railway Engineering:—

Not long ago I rode over a piece of track that shows vividly appreciation on the part of the maintenance of way department of the needs of a roadway during the winter months. All ties had been thoroughly tamped, track surfaced, ballast cleaned and neatly graded, ditches cleaned out or newly dug through every cut. The result was not only a smoothly riding track which is inclined to give but little trouble during the winter, but one also which was very pleasing to look at. This latter feature, in my estimation counts more with the traveling public as an advertising medium, than is usually supposed.

Illinois. Engineer.

Editor, Railway Engineering:

In my opinion the most important work to be done by electric railways in this section of the country in the preparation for winter is thoroughly to overhaul and place its electrical equipment, plows and cars in first-class condition, place snow fences, organize snow force, test track bonding, elevate tracks, if not already done, where car motors are liable to drag on snow or ice and systematize the handling of snow in connection with the board of public works in cities and with selectmen of small towns with the view of preventing friction if possible between the company and city or town officials. Keep your agreement with the city or town officials, do everything possible to keep your cars on scheduled time, if you cannot do it make an effort; show the people you are doing your best and, above all, keep the good will of the traveling public.

New Hampshire. Asst. Superintendent.

Editor Railway Engineering:—

The most important work to be looked after by section forces in preparation for winter is drainage.

Indiana. Roadmaster.

Editor Railway Engineering:—

In my opinion, I would suggest that in preparing track for winter, we first have a good appropriation for the track department, so as to furnish each section foreman with good gangs, so he can drain his track thoroughly, by ditching and cutting shoulders away from the ends of ties. By ditching, and giving the ground a gradual slant from the ends of ties to back of ditch, it drains all the water away from track practically, and prevents swinging and churning joints. This I have found from years of experience to be the best method of keeping track in first class condition during the winter.

Texas. Roadmaster.

Editor Railway Engineering:—

In my opinion the most important work for section forces in preparation for winter, is to get in all of the ties that are necessary, have the track filled in, drained and grassed, keeping the ties well drained at the ends; also get all wet cuts ditched out so as to give the track good drainage.

Illinois. Roadmaster.

Editor Railway Engineering:

In order to keep switches clear of ice and snow during the winter, it is the practice on this line during the month of November to go over the entire division cleaning out from between the ties for a depth of at least five or six inches below the bridal rods and switches, so that in case that these openings fill in with water that they can be dipped out by section forces. In other places where it can be done we usually make it a practice to dig trenches so that the water may run away from the switch. We find the latter method the best. In the yards we have to keep sufficient men on duty to keep the water away from the switches to keep them from freezing up.

Illinois. Supervisor.

Editor, Railway Engineering:

The only means I have used to keep switches clear of snow and ice is to employ men with their shovels and picks. I find that a liberal application of salt will very often take care of a light fall of snow, without any labor.

I never had any experience with trying to equip the switches with steam pipes. It seems to me this would be quite expensive, although no doubt effective. I am of the opinion that when there is a heavy fall of snow that moving it with a shovel is the most effectual method. This is, of course, very expensive.

Oklahoma. Roadmaster.

CONSTRUCTION.

Grading on the right of way of the Sacramento & Sierra, which will connect Sacramento with the timber belt of the Sierra Nevadas and run a branch line to Auburn is progressing. Crews are now busy in Placer County, Cal., and are working northward.

The Porterville Northeastern, which plans an 18½-mile line along the north bank of the Tule river from Porterville, has completed surveys and has secured the capital for constructing a line. Construction contracts are to be let at once. C. S. Freeland, Porterville, Cal., is Chief Engineer and T. U. Nofziger, Porterville, Cal., is President.

The Northwestern Pacific has taken bids for the construction of 80 miles of line, closing the gap between Eureka and San Francisco. The road lies through a rough country and the estimated cost of the 80 miles of line will be about $8,000,000.

The Grand River, Meeker & Salt Lake recently incorporated with a capital stock of $10,000,000, proposes the construction of a railway from a point on the Rio Grande and Colorado Midland lines, to the east of New Castle, in Garfield county to Meeker, in Rio Blanco county and thence along the White river to Salt Lake. It is reported in Denver that the line into Meeker will be completed within a year. The capital for this portion of the line, which will cost about $2,000,000, is said to have been secured, and all right of way obtained. The total length of the proposed road is 350 miles and surveys of the entire route have been made. The incorporators of the company are Alfred Muller, William D. Lippitt, William P. Simmington, Arthur Friedman and John T. McClure, all of Denver.

Construction work is progressing on the contract recently awarded the Utah Construction Co., Ogden, Utah, for building the 10-mile branch of the Oregon Short Line from Montpelier, Idaho to Paris. Sub-contracts have been awarded Walton & Nelson and K. L. Molen, who have established camps.

The McCarthy Improvement Co., of Davenport, Ia., has been awarded the grading contract for the extension of the Tri-City Railway, in Moline on Twenty-seventh street, to a connection with the Fourth avenue car line. The grading work will require the moving of 30,000 to 40,000 cubic yards of dirt.

Surveyors of the Chicago, Rock Island & Pacific are running lines for the construction of the proposed road from Des Moines to Allerton, Ia. With no serious delay it is ex-

pected to have the line constructed within a few months into Chariton.

The Westinghouse Electric & Manufacturing Co., Pittsburg, Pa., has been awarded the contract for the equipment for use in the Hoosac Tunnel, which is to be electrified by the Boston & Maine. The tunnel is 4¾ miles long, exclusive of approaches. The total length of the electrification work is seven miles.

Contractors on the Temple Northwestern are now finishing the last two miles of grading between Temple and Gatesville, and track laying is being pushed.

The Norfolk & Western has awarded contracts for the construction of 11¼ miles of track to be known as the Cedar Bluff extension: Rinehart & Dennis Co., Washington, D. C., two miles; Walton & Co., Falls Mills, Va., 2½ miles; W. O. Lipscomb, Roanoke, Va., two miles; A. H. Valz, Staunton, Va., two miles; P. J. Millett, Paris, Ky., 2¾ miles. Another extension, known as the North Fork branch, to consist of four miles, was awarded as follows: Vaughan Construction Co., Roanoke, two miles; Carpenter & Boxley, Roanoke, two miles. The cost will be about $1,500,000, and work will be started at once on all the contracts.

The Baltimore & Ohio has secured all material for the double tracking of its Wheeling division. Most of the material is now on the ground and the company is planning to go ahead with the work. The work is to be started between Fairmount and Grafton. Very little grading will be required.

The Canadian Pacific has taken over the charter of the St. Mary's & Western Ontario, and thus secured an entrance into the city of Stratford. The charter provides for a line from Stratford to Grand Bend, a summer resort on Lake Huron. This line will run in a southwesterly direction, passing St. Mary's, where the C. P. R. already has a line, within about three miles, and continuing on through Exeter and other smaller places to the lake. Then from some point on this line, presumably Stratford, a line will be built in a northwesterly direction to Linwood, a small junction point on the Toronto-Goderich line of the Canadian Pacific.

The National Railways of Mexico has entered into a contract with the state of Durango to build a railroad from Uiterrez, state of Zacatecas, to Durango, state of Durango. The line will pass through the mining districts of Sombrerete and Chalchihiuites. The same company, through H. M. Taylor, director of construction, City of Mexico, is making preparations to begin construction at an early date on its proposed line between Tampico and Matamoros, near the mouth of the Rio Grande, where it will make connection with the Frisco system. The survey for this prospective road is practically finished, and plans are now in the hands of the government for approval. The line will be about 300 miles long.

Jose Mondragon, City of Mexico, started grading work early last month on his contract for the extension of the National Railways from Oaxaca to Tiacolula. The contract was let Sept. 2, and the masonry work was started two weeks later. It is understood that this contract also includes the construction of the branch line to the smelter at Magdalena. The Tiacolula extension is 30 kilometers in length and will, when completed, bring the Totolapan mining district within easy reach of the railroad.

The New York Public Service Commission, First District, has extended the time to April 28, 1911, for beginning work on the extension of the Hudson & Manhattan subway from Thirty-third street and Sixth avenue to Forty-second street and Lexington avenue, in the borough of Manhattan, New York.

The Santa Fe is reported to have completed plans for the elevation of the tracks over Douglas avenue, at Wichita, Kan.

The Portland, Eugene & Eastern will build a new car house with repair equipment within a few months at Albany, Ore.

The Duluth, South Shore & Atlantic will build a new wood-working shop 80x250 ft. on the site of the building that recently burned at its plant in Marquette, Mich.

The Gulf, Colorado & Santa Fe has appropriated $42,900 to be used in improving the shops and providing additional machinery at Temple, Tex.

The Pennsylvania has filed plans with the board of public works of Fort Wayne, Ind., on which bids will be asked, for the construction of a new passenger station at that point.

The Canadian Northern will erect car shops for the entire system at Port Moody, B. C., on the Fraser river.

The Grand Trunk has contracted with the American Bridge Co. for 200 tons of bridge work at Chicago.

The New York, New Haven & Hartford has awarded a contract for the construction of a bridge near Providence, R. I., to the Boston Bridge Works. The structure will require about 500 tons of material.

The Chicago, Milwaukee & St. Paul will build a viaduct over its tracks on Washington avenue at Racine, Wis.

The New York Central has awarded a contract to F. J. McCain Construction Co., Mercer, Pa., for the building of a new bridge over the Mohawk river on the Black river division. The bridge will be of a double track steel structure.

The Oregon Trunk Ry. has let the contract for the steel construction of the bridge at the crossing of the Columbia river at Celilo, Ore., to the Pennsylvania Steel Co.

The Chicago and Western Indiana has awarded a contract for 2,300 tons of bridge material to the American Bridge Co.

The Chicago & Northwestern, the Chicago, Milwaukee & St. Paul and the city of Milwaukee, Wis., have completed plans for the elevation of tracks on the south side of the city.

The Lake Shore & Michigan Southern has let the contract for building a bascule bridge at Ashtabula, O., to the Pennsylvania Steel Co., Steelton, Pa.

The New York, New Haven & Hartford has had engineers in the field making a survey from Boston to Worcester, via Needham and South Framingham, with a view to determining the feasibility of a new line between those points. The plan, as at present contemplated, is to effect a connection between the Needham branch of the New Haven and the northern division, which runs into South Framingham. The engineers are also working on a route from South Framingham to Worcester, which would connect the Worcester terminus with its extensive eastern Massachusetts system. To connect Needham and South Framingham it would be necessary to build about eight miles of track and seventeen miles to connect South Framingham with the present line of the New Haven, presumably at or near Millbury, the old road being then followed into Worcester.

The report of the Chicago, Rock Island & Pacific, for the year ended June 30, 1910, shows that the line between Amarillo, Tex., and Tucumcari, N. Mex., where it joins the main line to the southwest, has been completed. The new line is laid with 60 ,65 and 70-lb. rail and provides a short route from Memphis, Tenn., via New Mexico and Arizona, to southern California. The distance from Memphis to Tucumcari is 873.72 miles over this line. New station buildings have been put up at Vega, Tex., Adrian, Glenrio and at Endee, N. Mex., and San Jon. On the completion of the new line the C., R. I. & P. discontinued the operation of trains over the Fort Worth & Denver City Railway, from Amarillo to Dalhart, 82.06 miles. The traffic rights were therefore relinquished.

CONVENTION OF THE AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.

The 20th annual convention of the American Railway Bridge and Building Association was held in Denver, Colo., Tuesday, Wednesday and Thursday, Oct. 18-20. The opening session was called to order by President J. S. Lemond of the Southern. Prayer was offered by J. N. Penwell, of the Lake Erie & Western, after which there was an address of welcome by a representative of the city government, to which M. F. Cahill, of the Seaboard Air Line, responded.

The attendance was good. About 120 members were present, the majority being accompanied by members of their families. There were also 41 representatives of 28 supply firms, with their families. The committee on membership reported 52 applicants for membership, all of whom were elected. The secretary and treasurer reported a balance of $1,600 on hand, with all accounts paid.

In his annual address President Lemond called attention to the present membership, which has reached a total of 460. The following is part of his address:

"In the past we were accustomed to mention the railroad mileage covered by members of this association, but it has now become so broad that it is only necessary to ascertain the total railroad mileage in the United States and 50 per cent of that of Canada, New Zealand and India and you have practically the mileage represented by the membership of this association. In its infancy it, like most other similar associations, began with a small membership, but it has grown until now it is like the backwoodsman's train. He had heard that a railroad had been built into a certain town, some forty or fifty miles from his home, but declared he did not believe it, but that he would find out; so he called his two boys and instructed them to have his two faithful oxen, 'Buck' and 'Ball,' ready to start at sunrise the following morning. Accordingly they set out across the mountains and valleys, traveling by day and camping at night. They traveled in this manner for three days, and when they arrived at their destination they learned that the road was actually there and the train had arrived and the engine had been put away for the night, but would leave early the next morning, so they were up early and went out to see it. When they reached the vicinity of the station the train was made up ready for the trip. They viewed it from quite a distance, at first, but finally grew bolder and got very near to it. The old gentleman scrutinized the locomotive very carefully and asked a great many questions, and when he was told that it was to pull the great string of cars coupled to it, he was very emphatic in his declaration that it would never do it. 'Why,' said he, ' "Buck" and "Ball" could not even move them, much less that little engine.' But bye and bye the time for departure arrived, and the engineman climbed aboard and gave it steam, and the engine began to throb and the wheels began to turn; slowly at first, but gradually increasing until a speed of twenty-five or thirty miles an hour was reached. About the time it turned a curve, half a mile away, which gave a fine ,broadside view of it he turned to those assembled and remarked: 'It did start it, but, by Jemminie, they will never stop it'; and, ladies and gentlemen, that is the way of this association. It moved slowly at first, but it has now attained such a speed that you will never stop it. You hear its merits extolled in gatherings of bridge men whenever they meet and our records were taken as authority on the great work of maintaining bridges and buildings. Speaking in a prophetic way, I look forward to a very bright future for the association. It is brighter today than at any other time in its history."

Cast Iron Culverts.

The first subject taken up for discussion was the report of the committee on cast iron culverts, on which many had lessons of experience to relate. Several speakers disapproved of the practice of encasing iron culvert pipe in concrete. If the opening is to be surrounded by concrete the best and most economical practice, it was asserted, is to make a concrete arch or box culvert and be done with it. Likewise where an expensive foundation must be prepared a concrete or reinforced concrete culvert is preferable to the cast iron pipe.

Mr. Cahill said that he was using some lock-joint pipe in culverts on soft ground, but he preferred to have a good foundation. He did not think the lock joint would hold the pipe together under heavy pressure. He does not approve a short-length pipe, preferring the 12-ft. lengths. G. W. Rear, of the Southern Pacific, spoke of the use of concrete culvert pipe, in 3-ft. lengths, of which his road is using a good deal. Ordinarily this pipe is not permitted to be used nearer the rail than 3 ft., but in cases where it is used nearer, as underneath the space between two ties, it is made double thickness. Wherever an expensive foundation must be made, to prevent settlement, a standard concrete or reinforced concrete arch or box is built.

From the remarks of other members it was evident that concrete pipe culverts are now being used extensively in perference to cast iron pipe. H. Rettinghouse, Chicago & Northwestern, said he had found that 48-in. concrete culvert pipe, in 8-ft. lengths, could be made and put in place at about half the cost of cast iron pipe, and 36-in. concrete pipe at about two-thirds the cost of iron pipe of the same diameter. The concrete pipe is made in large quantities, at a central point, from which it is shipped to the various culvert sites in the same manner as iron pipe. He is using, or will use, concrete pipe in about 250 places.

A. E. Killam, Intercolonial, has had a long experience with iron pipe culverts and has used a great deal of concrete pipe in culverts in a very cold climate. Concrete pipe is now his standard and is quite satisfactory. He is careful to place the pipe on a good foundation. In his practice concrete pipe must be a year old before it is laid.

There was considerable discussion on the trouble from culvert pipes pulling apart. Some had found the cause to be settling foundation, others the spreading of end walls from settling embankments or frost or from the jarring of trains. Mr. Penwell had seen iron pipe in culverts pull apart on a hard foundation that had not settled, the pipe remaining at the straight grade after pulling apart. He thought the cause was the action of frost and the jarring of trains. Several said they had had culvert pipes pull apart and still remain in good alignment. In such cases they had plastered up the openings with cement mortar and allowed the pipe sections to remain permanently apart.

Many had gone through the experience of digging out pipe culverts in order to pull back to place separated sections. They were of the opinion that the friction of the earth against the pipe was too great to move the sections together by jacking, and in their opinion the only possible method was to dig out and relay. J. H. Harkley, Toledo, Peoria & Western, said he had accomplished the "impossible," and his method was as follows: He first uncovered the ends of the pipes at the slopes of the embankment, for some distance inward, and then used rods with hooked ends to pull the material from around the pipe as much further inward as the men could conveniently reach. In this way the earth could be either removed or loosened around all but perhaps three 12-ft. lengths of pipe. He then made a bearing of cross timbers, for rods, at one end of the culvert and a cross bearing of timbers at the other end for jacks. The jacks were worked against a third set of cross timbers to which were attached the rods or long bolts running through the culvert. As often as heavy strain was put on the rods by screwing up on the jacks he used a 12x12-in. timber as a butting ram and the sections of pipe had to move. In this manner the sections were pulled together and all of the joints made tight, at no great expense. He had planned, in event of failure at the first trial, to adopt the method of using threaded rods alone. His scheme

was to use rods and cross tmibers, building a fire and heating the rods, and then taking up on the nuts when the rods became expanded in length. As the rods cooled they would pull the pipes together; and by repeating the process he expected to be able to take up all of the open joints. The success of his jacking method made it unnecessary to try the method of heated and cooled rods.

Building and Platforms.

The report of the committee on buildings and platforms for small towns was next presented. Two platforms were submitted: one provided for a combined passenger and freight station, with end platforms and another platform between the building and main track. This was unsatisfactory to many, because of the obvious necessity for unloading all freight from trains standing on main line.

Plan No. 2 had the same scheme, with a sidetrack at the back of the station, but no platform on that side. The fault found with this arrangement was the inconvenience or difficulty of getting wagons up to the freight room door when cars were standing on the sidetrack. R. C. Young, Lake Superior & Ishpeming, proposed the addition of a platform at the back of the station. Some expressed themselves in favor of end platforms as a good place to leave heavy machinery, so as to avoid the labor of moving it into the freight room and out again, while there were more who said that end platforms were usually occupied by chicken crates and other unsightly property that otherwise would have to be removed promptly from the station, and it was their practice to remove end platforms as rapidly as changes had to be made. Messrs. Cahill, W. W. Perry, P. & R., and others said that the stations at some towns require vastly more platform space than at others, according to the class and quantity of freight handled, and they did not see how a committee could recommend any design that would be satisfactory to the entire membership.

The result of the discussion was a vote to refer the report back to the committee for further investigation.

Curve Elevation on Bridges.

The report of the committee on Superelevation on Bridges showed diagrams for several methods of elevating the outer rail of curves on bridges. In the discussion G. Aldrich, N. Y., N. H. & H., recommended that in all cases the elevation be made in the structure rather than in the floor or ties. Referring to the diagrams, J. H. Markley said that he had always used Style "a," Fig. 3, for wooden trestles. For steel bridges he had formerly, when oak timber was cheap, used Style "a," Fig. 4, but since the price of oak had increased he has been using Style "c," Fig. 5. Lee Jutton, Chicago & Northwestern, and many others expressed the opinion that where heavy elevation is used it is best practice to obtain part of it in the ties and part in the structure, as by blocking up the girder.

Mr. Rear uses Style "c," Fig. 4, of which he spoke quite favorably. To obtain 6 inches of elevation in this manner he cuts an 8x16-in. tie down to 10 inches depth at one end, inward as far as the rail base, and then diagonally across, so that the stick remains full size at the outer edge of the base of the other rail; in other words the two rails stand on the tapered part of the tie, allowance being made for extra length of taper where tie plates are used. Mr. Rettinghouse and others approved of this method. The only objections offered to it seemed to be waste of timber and the expense of framing the ties. Mr. Rear has the ties so framed in the shops. The discussion became rather spirited, and was ended by adopting a motion by Mr. Jutton, providing as follows:

For superelevation on pile and framed trestles this association recommends Style "a," Fig. 3; for I-beams and deck plate girders of medium length, on concrete foundation, Style "a," Fig. 1; for I-beams and deck plate girders of medium length (or shorter) on masonry, Style "b," Fig. 1; for through trusses, through plate girders, deck plate girders of long span and deck trusses, Styles "a," "b" and "c," Fig. 4.

Wire Glass.

The convention began work on Wednesday morning by considering the committee report on the use of wire glass. W. M. Clark, B. & O., said his principal difficulty with overhead glass was the frames. Iron frames for wire glass in train sheds must be renewed every three or four years, and he would recommend the use of copper. For roundhouses, where breakage of glass is always frequent, he would recommend only small sizes, like 8x10 or 10x12 inches. For overhead lights in train shed A. E. Killam uses ribbed glass, with galvanized iron frames. He had found that wooden frames decay too quickly.

For lights in walls the preference of nearly all of the speakers was for plain glass, and it was the opinion of the majority that a mistake in the past had been made in the use of panes of too large size in shops and roundhouses. Mr. Spencer urged the use of heavier wooden sash, with common glass, set with beads and screws instead of putty. The expense of continually replacing glass with putty in roundhouses was a large item. Mr. Killam recommended the mixing of white lead with the putty, and J. H. Markley said that if the putty was made by the user of good whiting, there would be no trouble, but the putty on the market these days is made of marble dust and is short lived. Some one suggested that a plentiful use of glazier's points with the putty would hold the glass in.

Mr. Rear said that, as a matter of safety, wire glass should be used in all overhead lights, regardless of the expense. A. H. King, Oregon Short Line, said his company had adopted wire glass for overhead work extensively, using metal sash, and he has found a material reduction in maintenance expense. Mr. Rettinghouse is using sash with 1-inch mullions, with wooden beads and screws instead of putty. By reason of the mischievousness of small boys and hunters he is using wire glass in the cases of the disk signals.

Tank Hoops.

The report of the committee on hoops for water tanks was read by Chairman F. E. Wise, Chicago, Milwaukee & St. Paul. This committee had made an investigation of the use of flat, round, square and segmental hoops on water tanks, and presented interesting data of practice, with specifications. Nearly every one had something to say on the subject, and the preference for wrought iron hoops seemed to be almost unanimous. Many instances were cited where tanks with flat wrought iron hoops were still standing in good condition after a service of 35 years and longer, without renewal of the hoops. No one put the life of steel hoops at more than 10 years, and in many cases they had corroded and come off in five years. The use of so-called soft steel hoops had likewise been disappointing. W. O. Eggleston said that steel tank hoops had been nothing but a source of annoyance to the engineers of the Erie. He knew of many tanks with wrought iron flat hoops, 1/8x5 inches, 3/16x6 inches and 3/8x7 inches that had been standing 35 years without changing a single hoop, and these tanks were adjacent to roundhouses and cinder pits.

It was generally recommended that the tubs and inside of hoops should be well painted one or two coats, and that the paint be allowed to dry well before the hoops are put on. Mr. Killam said that he follows the practice of painting the edges of the staves, also, with white lead and then coating those painted edges with tallow, so that the stave can adjust itself as the hoops are tightened without fracturing the paint on the wood. He still prefers tapered tubs with riveted flat hoops driven down to a fit with a wooden beetle and set hammer.

There seemed to be no weighty objection to round hoops if made of wrought iron, although experience was too meagre to be convincing; but flat hoops of wrought iron had been so satisfactory that it was thought nothing better could be produced.

The result of the discussion was a motion by Mr. Eggleston

recommending wrought iron flat hoops for water tanks as the best practice, and the motion carried by a practically unanimous vote.

The election of officers for the next year resulted as follows:

President, H. Rettinghouse, Chicago & Northwestern.

First vice-president, F. E. Schall, Lehigh Valley.

Second vice-president, A. E. Killam, Intercolonial.

Third vice-president, J. N. Penwell, Lake Erie & Western.

Fourth vice-president, T. L. D. Hadwen, Chicago, Milwaukee & St. Paul.

Secretary, C. A. Lichty, Chicago & Northwestern.

Treasurer, J. P. Canty, Boston & Maine.

Executive committee, T. J. Fullem, Illinois Central; Grosvenor Aldrich, New York, New Haven & Hartford; P. Swenson, Minneapolis, St. Paul & Sault Ste. Marie; G. W. Rear, Southern Pacific; W. O. Eggleston, Erie; F. F. Steffens, Boston & Albany.

St. Louis, Mo., was selected as the place for holding the convention next year.

At the closing session, October 20, methods of protecting embankments against currents and restoring them when washed out, and fire-proof oil houses, were the subjects taken up for consideration. The report on oil houses was accepted and Secretary Lichty said that certain plan drawings of oil houses additional to those shown in the report would be published in the proceedings. The report on bank protection was accepted and the committee was instructed to continue its work.

H. Rettinghouse, Chicago & Northwestern, said that the only way to protect banks along such streams as the Missouri river is by woven brush mattresses well loaded down with rock. He referred to the Sioux City work of the Chicago & Northwestern. In this work, after considerable experience, it had been found that the driving of piles was not an efficient means of preventing wash. The river is continually changing its course and the railway has been compelled to spend a considerable sum of money each year to protect its roadbed. William Spencer, of the same road, told of his experience at a bridge where a combination of piling, willow matting and rock filling had lately been adopted as a substitute for pile driving alone, and the stream had in this way been put under control. In the past $50,000 to $60,000 has been spent each year, for a long time, without permanent effect. He has adopted the use of "ton stone" (large stones) with small stone clinked in between, in preference to ordinary riprap. The company works its own quarry and gets out stone at 40 to 60 cents per ton, loaded at the quarry, and at an additional expense of 25 cents per ton for laying in place.

J. M. Staten, Chesapeake & Ohio, spoke of difficulties formerly experienced with 230 miles of road along the James river. In some cases the flood would rise above the tracks, sweep them off the roadbed and turn them bottom up. To prevent this he now drives chestnut piles 10 ft. long under the ends of ties, two to each rail length. While each pile is being driven the tie is swung to one side and then straightened back to place. A ⅞-in. hole is then bored through the tie and it is drift-bolted to the pile, the head of the bolt remaining on top of the tie. By such means he is enabled to hold the track on line in high water.

The Missouri Pacific and Iron Mountain have both the Missouri and Mississippi rivers to contend with, and a special department was organized some years ago under an engineer of river protection.

J. N. Penwell advised the planting of trees on railroad banks and river banks as a good means of protection against wash. It is a natural method. Ordinarily willow trees are good for this purpose.

F. C. Kyte, engineer of the Pine Bluff & Northern, a line under construction in Arkansas, has resigned to take a position on Madeira-Mamore Railway in Brazil.

J. M. R. Fairbairn, principal assistant engineer of the Canadian Pacific, has been appointed engineer maintenance of way, Eastern lines, with office at Montreal, Que.

WIRE GLASS.*

Owing to the incompleteness of the information they were able to obtain the committee did not feel in a position to make any recommendations on the subject.

Wire glass costs about 50 per cent more than plain glass. It is less liable to do damage after being broken, on account of the wire preventing pieces from falling. Plain glass with a wire netting hung underneath, is not efficient, as the netting may rust away so quickly that its renewal is quite an item of expense.

Large sizes of wire glass are not economical; first, because of the additional cost of large sizes; second, because of the additional chance of large sizes being broken. Sizes 24x36 inches in skylights, and sizes 36x40 inches in doors and partitions, should be economical sizes.

Gas and smoke from locomotives, because of its influence on the metal framework of train sheds and skylights of roundhouse, is the primary cause of the breaking of much glass. Contraction and expansion of metal frames is also a serious cause of breakage where glass is tightly fitted to the frames. Glass set horizontally, or at an angle breaks more readily than glass set vertically. Wooden bars for frames or sash are preferable to steel, on account of the effect of gases on steel bars; also there is less liability of breakage by expansion and contraction where wood is used. It is not practicable to use wire glass in roundhouse doors and windows, but it can be used in skylights and monitors of roundhouses, in train sheds and in roofs of shops, and in station buildings.

Wire glass windows and partitions in buildings will withstand extreme heat without breaking and falling out, and thus prevent the spreading of fire to some extent. Several fire chiefs from the larger cities have recommended that it be used wherever possible to do so.

Below is appended a copy of our circular of inquiry and some replies to it:

Inquiry as to the Economy and Practicability of Wire Glass in Roundhouses, Shops and Station Buildings.

1. Do you use wire glass in buildings under your jurisdiction?
2. To what extent?
3. Do you use rough, ribbed, or polished glass?
4. What is the relative cost of each?
5. What is the relative cost of wire glass to that of common glass of the same dimension?
6. Is it practicable to use wire glass in roundhouse doors and windows?
7. What size and thickness of wire glass is economical to use in doors, windows and partitions where the glass stands vertical?
8. What size and thickness where the glass lies flat or at an angle, as on a roof or skylight?
9. What is the relative cost of maintaining wire glass to that of plain glass of the same dimensions?

REPLIES.

D. A. Shope, A., T. & S. F.—I will state that on the Valley division, and I believe this holds good with the entire coast lines of our road, we have done away with the use of wire glass in our buildings. At one time we did use the wire polished glass, but for some reason the company discontinued its use and we are now using plain glass instead.

My experience with wire glass has been limited, but I notice that where it is used in doors and windows it breaks the same as the plain glass. It is usually broken with nuts, bolts or some other hard substance thrown against it. In other words, it receives the same kind of treatment as other glass does.

I believe that it is more economical to use the plain glass

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*Report of committee to the American Railway Bridge and Building Association.

While it may have to be replaced oftener, still it is cheaper. I would prefer the plain glass with a 5/8-in. wire netting over the window. This I find to be effective.

H. H. Pollock, P. C. C. & St. L.—As almost all glass around engine houses and shops is broken by flying pieces of steel, such as rivet heads, etc., I do not think wire glass would reduce the cost of maintenance, for it would certainly break under such conditions. We aim to use small size glass around our engine houses and shops, so that when a missile goes through the damage is small. Glass such as we use will cost about four cents per light.

Geo. W. Andrews, Baltimore & Ohio.—We use a large amount of wire glass in buildings on this system, principally in skylights of train sheds, warehouses, stations, etc. Our main office building in Baltimore has all windows in the fourteen stories of polished wire glass, the sizes used running anywhere from 18 inches square up to 24x60 inches. The glass used is both rough, ribbed and polished; usually rough or ribbed on skylights and polished in doors and windows.

I consider it practicable to use wire glass in any opening where glass may be required. It is not economy to use it for all purposes, as the glass costs practically double that of plain glass.

We have experienced a great deal of trouble with wire glass, caused by cracks due to expansion and contraction, the cracks very often causing leaks, especially in skylights. I believe this could be overcome in a great measure by allowing more space between the skylight bars, thus giving the glass room to expand. My recommendation in this matter would be to use wire glass in all skylights, and in all buildings that it is desired to make fire-resisting. I do not think it would be economy to put it in buildings of a temporary character or in frame buildings, other than in skylights as first mentioned.

M. M. Barton, Pennsylvania.—We use wire glass in train shed skylights and monitors, pier shed skylights and in buildings where fire protection is deemed necessary. We use the rough glass for skylights and monitors and polished article in doors and windows of buildings.

Rough wire glass 22x24 inches wide by 72 to 90 inches long and 3/8 inch thick, costs 22 cents per square foot. This is used in skylights on train sheds, piers and freight houses. Rough glass (not wire) of same dimension sizes costs 13 cents per square foot. Polished plate of same dimensions costs 48 cents per square foot. None of this glass will hold an even thickness. Variations of 1-32 to 1-16 inch are frequent. Polished, wire and common plate glass in the trade is listed 1/4 inch thick, but varies the same as does the 3/8 inch thick rough. Polished 1/4 inch thick wire glass, in sizes up to 18x24 inches, costs 40 cents per square foot. Rough glass 23x23 inches by 1 inch thick in use on veranda over sidewalks, Broad Street station, costs 70 cents per square foot. Florentine glass used in elevators, doors, shafts and partitions, also figured rolled glass 1/8 inch thick, with a variation of 1-32 inch, costs 12 to 15 cents per square foot. These prices are based on 1909 net quotations. At present there has been a sharp advance in the price of all glass, especially polished wire and plate, which have advanced 40 to 60 per cent.

It is practicable to use wire glass in roundhouse doors and windows, but I do not approve of its use for this purpose It is economical to use in windows and partitions where the glass is vertical panes not over 1/4 inch thick and in sizes up to 18x24 inches. When this size is exceeded the cost advances 75 to 80 per cent.

Since the liability to breakage in wire glass is less than it is with plain glass, I believe the cost of maintenance is less than it is with the plain glass.

The office and staff of C. C. VanArsdol, division engineer of the Grand Trunk Pacific at Prince Rupert, B. C., has been transferred from Prince Rupert to Hazelton.

SUPERELEVATION ON BRIDGES.*

Superelevation of the outer rail for curves on bridges may be obtained by one of the following general schemes, or a combination of two or more of them:

1. By building the masonry bridge seats out of level or by using beveled shoes of different heights under the bridge bearings, as in Fig. 1.
2. By building the stringers or girders supporting the ties so that their tops will be out of level (Fig. 2).
3. By capping the trestle bents, either pile or frame, out of level or the equivalent of using a tapered cap, a tapered shim on a level cap or by tilting a framed bent on inclined footings (Fig. 3).
4. By tapering the ties, as in Fig. 4.
5. By shimming under the ties, as in Fig. 5.
6. By shimming under the high rail, as in Fig. 6.

Thirty replies were received to a large number of circulars sent out by the committee and the first five of the methods above received approximately equal numbers of advocates. No. 6 has no supporters.

Ballasted-floor bridges are not here specifically considered. They solve the question of superelevation at once, without special consideration; although for bridges of this class on curves some provision should be made to prevent trackmen or the action of trains from throwing the rails from their exact prescribed position, else there may be trouble from improper clearance.

1. In Fig. 1 the girders are inclined from the vertical. For moderate elevation it is advocated by twelve replies. Some doubt the advisability of this inclination, on account of the action of the live load; but one thoroughly competent engineer considers that the girders in this position support the loads more conformably to the calculations. It is likely that high speed trains will strain the transverse bracing less, and slow trains more, than if the girders were vertical.

Several object to Sketch "a," on account of the difficulty of building the masonry. If of concrete, however, such difficulty is not apparent. Many advocate securing part of the elevation in this way and the balance in the ties.

Several replies class this scheme as bad practice. It is of course out of the question for truss spans.

2. Thirteen replies favor the scheme in Fig. 2. A few object to it on account of dapping the ties across the grain. Cases are numerous where ties have split when so dapped, necessitating bolts. The scheme is applicable to deck and through girders as well as to truss bridges.

3. The method shown in Fig. 3 applies only to timber trestles, either pile or frame. Fifteen approve one style or other of this figure. A few object to "a" as difficult framing or as being unsightly. Plans "b" and "c" require an excess of timber, and "c" furnishes a bad joint for inducing decay.

Plan "d" is advocated by only one reply. The purpose of this style seems to be to secure square framing.

The committee is not a unit on this matter, but those having the largest number of trestle bridges prefer Style "a," and experience no difficulty in its use.

4. Seventeen expressed approval of some style of tapered tie (Fig. 4). All should have a certain minimum depth under the low rail equal to the standard for the stringer spacing in use.

Several members object to tapered ties of any kind, holding that the regular stock size for straight-line bridges should be used in all cases to simplify labor and material carried for repairs.

Style "b" allows the use of a smaller stick than "a" for a high elevation and is just as efficient.

Style "c" is the standard on the Boston & Maine road for metal bridges. It is somewhat expensive, in that it has to be adzed to shape, but bridges on curves are of no great length

*Report of Committee of American Railway Bridge and Building Association.

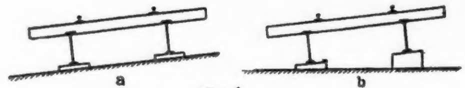


Fig. 1.

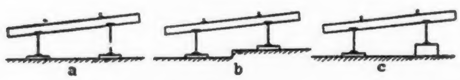


Fig. 2.

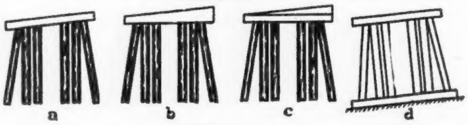


Fig. 3.

Fig. 4.

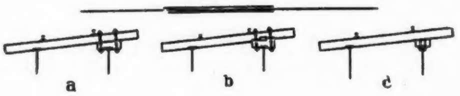


Fig. 5.

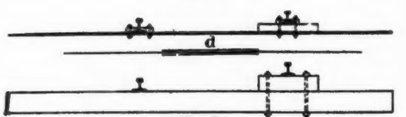


Fig. 6.

and the labor item for a given bridge is hardly appreciable. Its advantage is that the depth at the thin end is not reduced too much for properly holding the guard timber, and that the low rail is not canted away from the traffic, as it is on all other inclined ties.

Style "d" is advocated by one reply as a good method on a double-track deck with long ties. The shim is 8 feet long and is well bolted to the tie.

5. Nine advocate shims under the ties (Fig. 5). Several object to these on account of their getting out of place, etc. Plan "b" was used by the Baltimore & Ohio R. R. when 16-inch timber was in style. Plan "a" does not give sufficient elevation and can hardly be subject to this objection.

Style "c" is advocated by some and objected to by others. It is a longitudinal timber as wide as the girder flange and bolted thereto.

Style "d" is used on solid plate-floor bridges without ties. It is objectionable on block signal lines, as perfect insulation is uncertain, which necessitates cutting the bridge out of the circuit, so that a car on the bridge or a broken rail on it would not put the signal at danger.

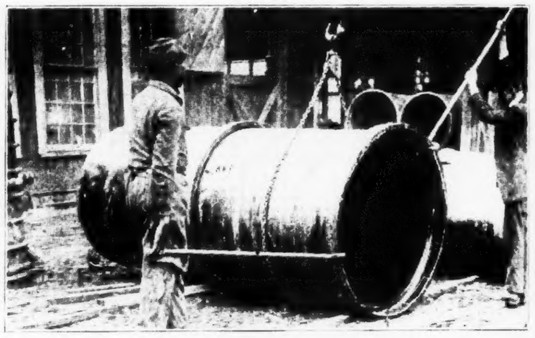
The scheme as portrayed in Fig. 6 received no support among the replies, except for temporary work.

All the schemes shown except No. 3 apply to metal bridges. It is well agreed that timber bridges of all kinds should have the stringers placed in a plane parallel to that of the rails. In the case of trestles it is the opinion of the committee that there is no valid objection against framing the caps to the proper inclination to receive the regular standard straight-line tie. In timber stringer bridges resting on masonry, tapered wall plates should be used.

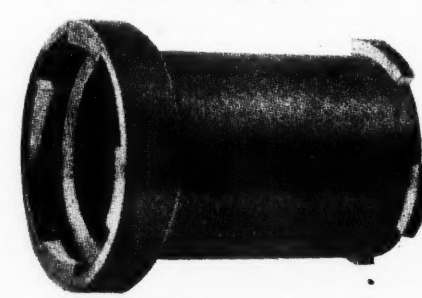
For metal bridges any of the schemes described will give good service if the fitting of the ties to the bridge and of the bridge to the masonry is perfect, so that no movement will occur. The simpler these fittings are, the more certain it will be that good fits will follow. To secure favorable conditions of simplicity the masonry should be level and the lower face of tie should be parallel to the plane of the top flanges of the stringers.

These conditions reduce us to "b" of Fig. 1 or to Fig. 4. Our replies indicate that not over 4 in. superelevation should be obtained by scheme 1; hence if more is required it should be obtained wholly by 4 or by a combination of 1 and 4.

Lock Joint Cast Iron Pipe Assembled.

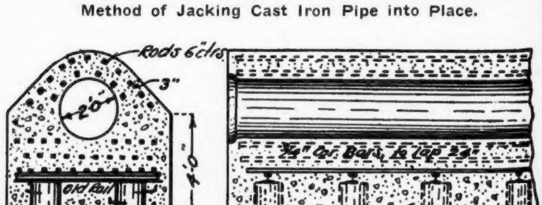


Method of Locking Pipe.

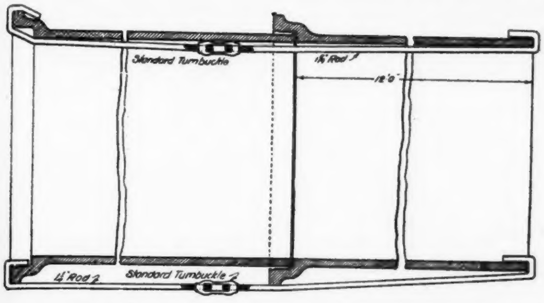


Section of Lock Joint Cast Iron Pipe.

Method of Jacking Cast Iron Pipe into Place.



Method of Laying Culvert in Soft Ground.



Method of Clamping Cast Iron Pipe Together.

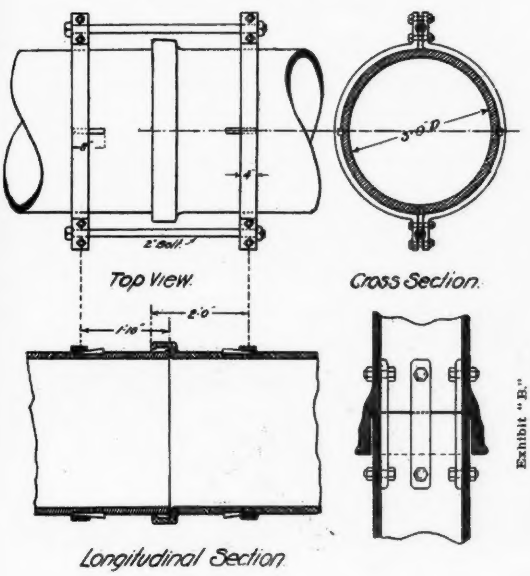


Exhibit "B."

Exhibit "A."

METHODS OF PROTECTING EMBANKMENTS AGAINST CURRENTS AND RESTORING THEM WHEN WASHED OUT.*

If a sufficient number of openings were left in embankments and the structures built in a workmanlike manner, railroads would not be so liable to washouts. They are now, and have ever been, too much inclined to reduce openings. In many instances serious washouts occur because ordinary trestles have been built where there should have been larger clear waterways. In trestles the bents may be of piles, well driven, but should there come an accumulation of drift, the earth may be scoured from around the piling, and cause the bridge either to be washed away, or the flow of water retarded and a washout occur at the approach of the trestle or other point, and frequently rise to flow entirely over the roadbed on either side of the structure.

In addition to this, a stream that frequently gives trouble and causes serious delay to traffic may overflow and fill in the land on the upper side of the road. If this condition is allowed to continue a few years it may become necessary to raise the track in that vicinity, particularly if the soil is of a sandy nature.

When several panels of a trestle are washed out and it is desired to pass trains quickly, a good plan is to point piles and work them into the soil with cant hooks. When all the piles have been set and braced, place sash near the grade and jack them in. After all of the bents have been placed in this manner, with the track standing sufficiently high to allow for settling, run empty cars over the structure to settle it, and then block up. Then run over the loads, after which allow the engines to cross, but the first engine should not move slower than ten miles per hour.

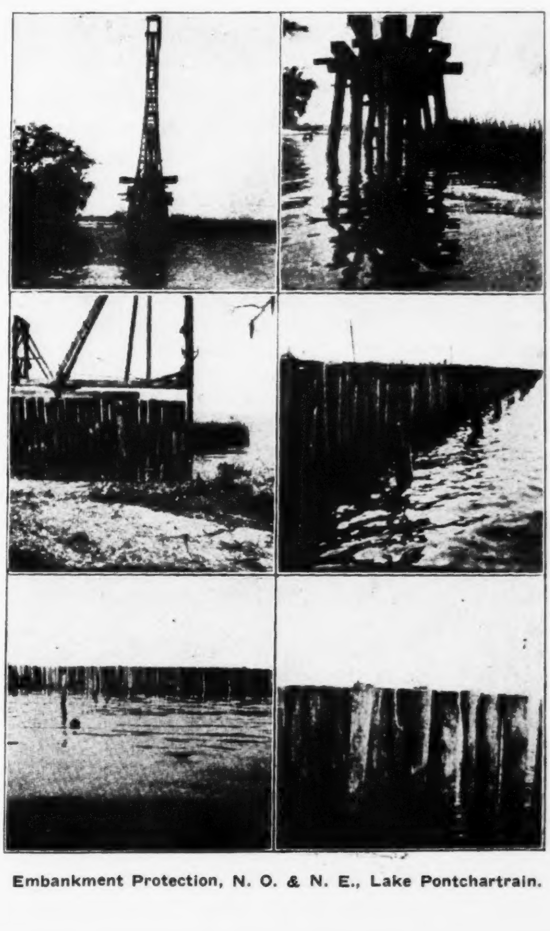
Work done in this manner will require close attention until piles can be driven. Frequently such a temporary structure can be built and traffic resumed before a pile driver can reach the defective point. The piles for this temporary structure can sometimes be cut from woods near the washout.

It is again often the case that culverts are placed under roadbed sufficiently large to carry the water, but they become choked with drift and the fill is blown out. Such danger can be obviated by making the opening larger. We, of course, realize the importance of removing or burning any brush or obstruction at or near the mouths of culverts or trestles as often as such accumulations occur.

We will now pass to consideration of the case where high water has washed out the roadbed and the track has been carried from the fill. Where the fill is low and the track is not turned over, it can readily be lined back to its original bed without taking it apart; but, if the track is turned over it is cheaper to first remove the ties from the rail. In that event have the ties placed on the roadbed and the rail moved to one side by lifting it with a large force and dropping it upon the ties without uncoupling.

The most difficult problem encountered in such a case is in separating the ties from the rails. A good plan is to cut poles 10 to 12 feet long, and, using them as levers, pry off the ties. This method has been made use of quite successfully.

It frequently occurs when the roadbed is badly washed that water is encountered too deep to crib, but temporary bents may be placed in such holes to advantage. This difficulty occurs particularly where there is a large river to contend with.



Embankment Protection, N. O. & N. E., Lake Pontchartrain.

*Report of Committee of American Railway Bridge and Building Association.

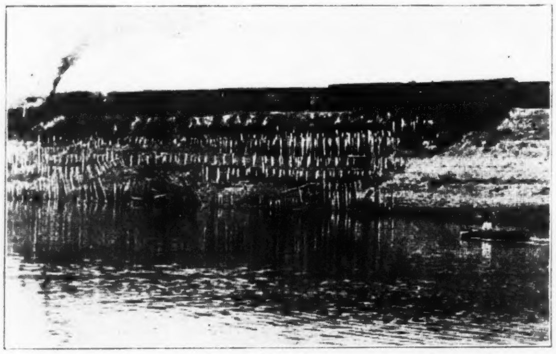


Fig. 1. Slides in Front of A. & V. Property, Vicksburg.

In cases where slides have occurred, caused by the current undermining the roadbed, and rock cannot be secured, it is advisable to drive piling at the lower edge of the fill and begin a wall of timber well under ground. Timber of 12 x 12 inch size should be placed on the side of the piling nearest the track. This construction will hold securely until the timber decays.

If the earth is of prairie formation it is subject to cracking during dry weather, and when the rains begin the water is absorbed by the cracks, and if the fill is inclined to slide, from any cause, it is more liable to do so after heavy or continuous rainfall. This can be prevented by ballasting and spreading the ballast to the slope from the ends of the ties to the outer edge of the fill. A spread of four to six inches, to retain the moisture, is required. The cracks will not occur where the sun is kept from the earth. Clay or soil of a sandy nature will answer when ballest can not be obtained.

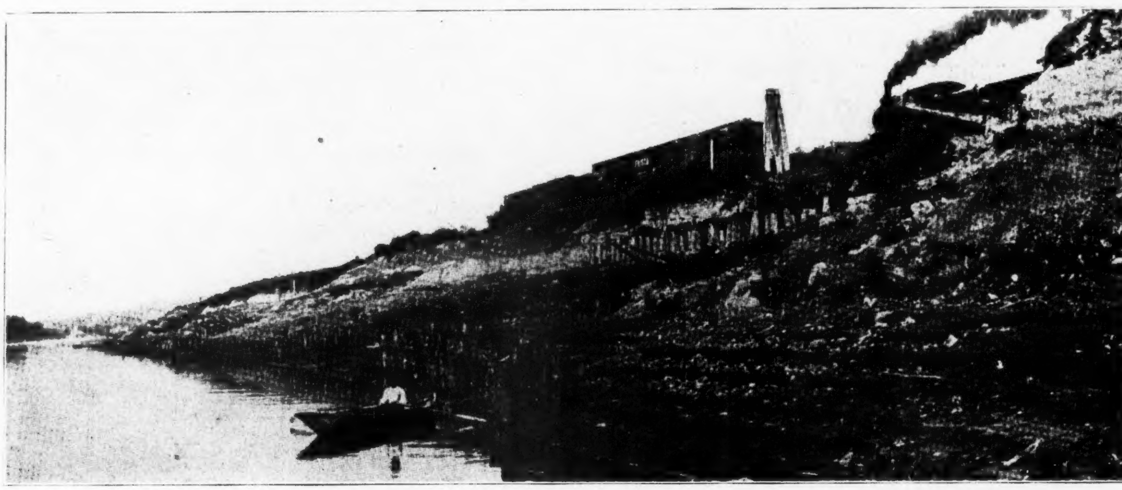


Fig. 2. Slide in Front of A. & V. Property, Vicksburg.

Should the water carry the track from the roadbed and it lodge against trees it should be floated back to its original bed while the water is up, if possible. It may be pulled in by a hand crab or with an engine.

Where the overflow occurs frequently the track should be raised above the danger line. Until this can be done the trestle should be securely anchored and the track ballasted with heavy stone or slag. If it is not possible to secure either kind of ballast, a Bermuda sod is very good. The track also should be anchored at such points. This can be done by driving piles alternately 30 feet apart. A very cheap and effective way is to bore holes near the ends of the ties alternately 30 feet apart, and drive a 1¼ inch bolt into the roadbed, leaving the nut on the upper side. The work of driving can be done from a push car.

Where bad washouts have occurred and much cribbing has to be done, a steam derrick is one of the handiest tools obtainable for loading timber and placing it on the roadbed, particularly so if the timbers are long and heavy.

A wash or slide may occur at the side of a fill or near the mouth of an opening. Such trouble is frequently due to the manner in which water is permitted to strike the opening, and it can frequently be obviated by changing the current. Should it not be practicable to change the water course where it runs parallel with the roadbed, it may be riprapped with heavy stone. In such a case it is a good plan to dig a good foundation two feet below the surface, begin the wall in the ditch and run it up at a slope of 2 to 1. The bottom of the ditch or channel should be floored with heavy stone. Such construction will frequently answer the purpose of a concrete wall and can be built much cheaper. A wall should be used at the ends of all trestles that are subject to wash.

If the fill is of a sandy nature the entire embankment is inclined to wash, but if a spread of four inches of cinders be placed on the fill to the edge of the slope, on either side of the ties, the bank will not wash at all on top and not nearly so bad on the sides. The falling water, being absorbed by the cinders, does not flow down the sides of fills with such force.

Where the track is placed back on the roadbed and trains

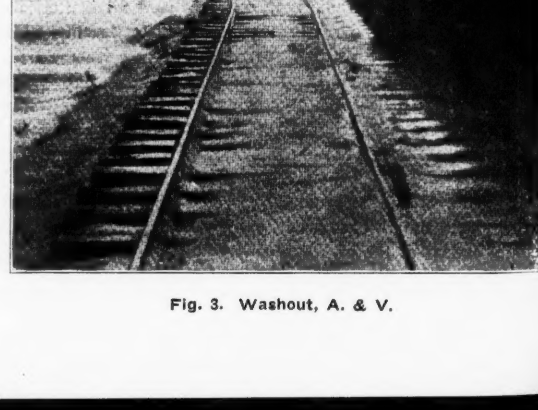


Fig. 3. Washout, A. & V.

Fig. 4. Washout, A. & V.

begin to move, the pile driver should begin work to replace temporary trestles. Slag or stone should be used to ballast the track and fill up small washes, but if neither stone nor slag be available, the next best material with which to surface is clay. The timber used for cribbing should be removed as the track is surfaced.

Where heavy drifts of debris accumulate against a trestle or piers a derrick car with a wrecking crew can be used advantageously; in fact much more satisfactorily than an engine with block and fall. In removing drift to relieve a structure it is sometimes advisable to use dynamite. Where heavy washing or scouring is being done by the currents and rock is not available, use bags of sand freely, as they can frequently prevent bad breaks in the roadbed.

There are cases where nothing in the way of a temporary trestle would be advisable, and piles must be driven with ex-

Fig. 5. Washout, A. & V.

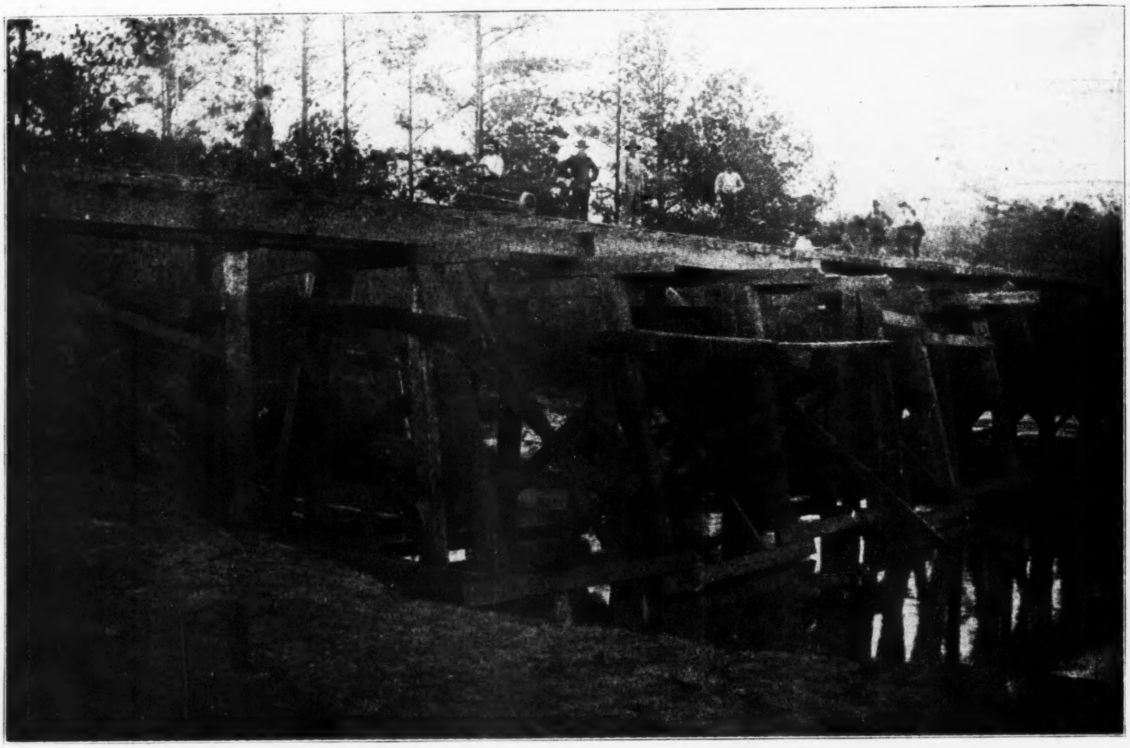


Fig. 6. Temporary Trestle, A. & V.

tension drivers from both directions. Where there is no water to interfere, frame bents should be erected in addition to driving piles; but if plenty of 12 x 12 timber and cross ties are conveniently at hand, cribbing can be used to advantage. The foundation for cribbing should be built of 12 x 12 timbers or stringers, and placed so as not to interfere with the driving of piles after the traffic has been resumed. This can be quickly and effectively done by building pens. Bents can then be driven between the pens. Again, if there is a sufficiency of long 12 x 12 pieces, use them after getting the foundation timbers in. This can be done quickly, particularly if the timbers are handled with a derrick car.

When a bridge is found to be settling due to scour under a pier, it is necessary to drive a bent on either side of the pier as

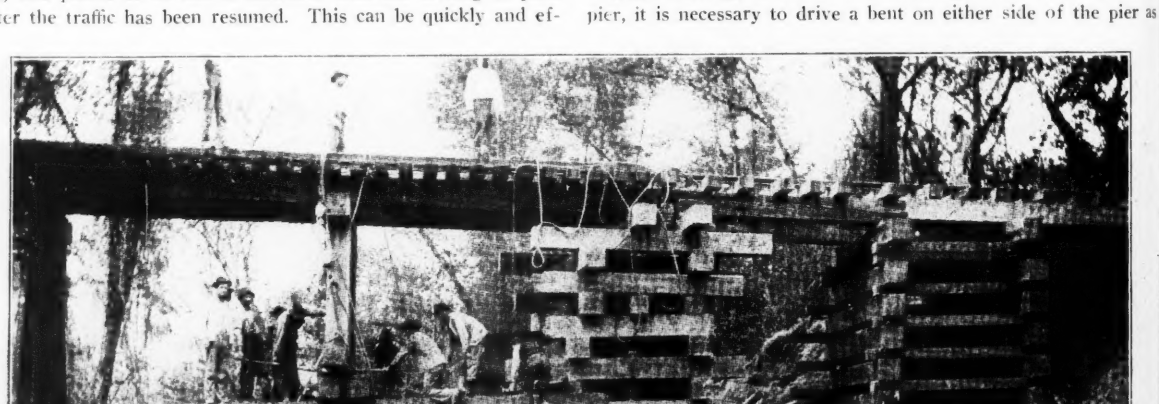


Fig. 7. Temporary Bridge Work, A. & V.

Fig. 8. Building Levee with Sand Bags, V. S. & P.

quickly as possible. After getting two bents in on either side and the bridge seated on the timbers and bolted, the trains can be passed with safety until the pier is reset. If it be not possible to drive piles, place false bents until the settling can be stopped, after which drive the piling as directed. Sand bags or stone dropped around the pier frequently prove beneficial.

Should a wash or slide occur on one side of the roadbed, where the bank is still good on the opposite side, and the track cannot be lined over far enough to carry the trains, drive piles eight feet apart near the rail and place a 12 x 12 timber on the piles longitudinally under the rail, to support the track.

Mr. J. C. Haugh, Resident Engineer of the New Orleans & Northeastern R. R., furnishes photographs showing method of protecting the embankment along the shore of Lake Ponchartrain against storm waves from the lake, a distance of about twenty miles, which was originally a pile trestle and later filled by means of a floating dredge which was operated on the opposite side of trestle from the lake. The material used in filling was composed of shells, sand and marshy soil.

The piles vary in length from 26 to 40 feet, depending on the depth of the water. They are driven about 16 in. centers and on a line 100 feet from center of the main track. Spacing the piles 16 in. centers allows 4 to 6 inches between the piles from the surface of the water to the bottom of the water. The storms beat more or less sand and shells between the piles and material filling has resulted. In addition, the space allows the waves to break, and part to go through, whereas a solid wall would cause the waves to fall back and undermine.

The piles are cut off 8 ft. above low water. The driving is done with a "creeper," or land driver, and the overhang is some 18 feet. Every 18 feet two outside piles are driven and temporarily capped to carry the driver. The cost for driving is 15 cents per foot of pile. Some of these pile butts show "cat faces," or scars, from cutting for turpentine. These are very rich and resinous, and extend down two feet and over, and as the piles in the water are always wet, but little decay has resulted in some fifteen years.

Considerable trouble has been experienced with sliding embankments of the Yazoo Canal along the tracks of the Alabama & Vicksburg Ry., at Vicksburg, Miss., prior to 1876. This embankment was the east bank of the Mississippi river, the stream in that year having changed its course southwestward one and one-half miles. This embankment is about 40 feet above zero water and apparently has a sub-drainage during the low stage of the river, causing the bank to slide. A method for stopping the slide, suggested to us by an engineer of the United States Government, was to drive piling close together in rows, these rows being at least 50 feet apart; but this method failed in its purpose. Fig. 1 partially shows the failure of the plan. Later it was decided to drive piling in a manner similar to that of foundation work, spacing the piles from 4 to 6 feet apart in all directions, which has stopped the slide altogether. We have been unable to drive all the piling, however, on account of the low stage of the water. When the proper stage of water will permit, we will drive the balance of the piling to complete the work as planned. We have driven in this slide about 1,400 piles 35 to 40 feet long.

Fig. 2 shows a new slide developing further down the river, with piling driven to check the same. For this work a floating pile driver equipped with a No. 1 Vulcan steam pile hammer, was used, weighing 10,500 pounds. The piles were driven with the butt ends down, which offers more resistance and strength at the bottom of the slide where it is most needed. The driving of 40 or 50 piles constituted a day's work.

Figures 3 and 4 show the effect of high water on the Alabama & Vicksburg Ry., washing out many holes 10 to 150 feet long, and from 1 to 10 feet deep. The track was washed off the embankment at a number of places, but it was restored by lining it back and cribbing the holes with track ties, using 12 x 12 pieces for stringers.

Fig. 5 shows a trestle washed off the right of way. This was originally a pile bent trestle, and later when the piling became decayed it was replaced with frame bents. This washout was repaired by setting up new frame bents on the old pile foundations, using 12 x 12 timbers for temporary stringers.

Figures 6 and 7 show approaches to a span bridge washed out

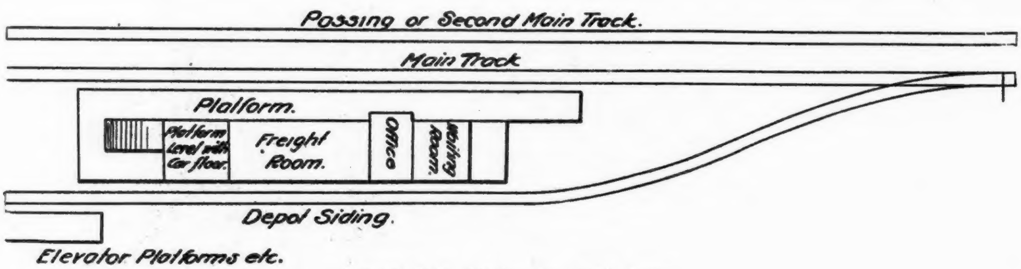
and repaired. One approach, as in Fig. 6, was repaired by standing 12 x 12 timbers on rock bottom, capping and bracing the same for bents. The other approach (Fig. 7) was repaired by cribbing with 12 x 12 sticks under the end of the trestle approach and in a section of the hill that was washed out.

Fig. 8 shows a method used by the Vicksburg, Shreveport & Pacific Ry. in building a levee with sand bags to protect the track against high water, this being the one often used for protection of embankments and toes at the ends of trestles and bridges. This shows a plank retaining wall back of the sand bags, which was built to protect a lean embankment, and for the purpose of holding the sand bags from sliding down the slope.

rels. This allows cars to be released and barrels or drums returned without delay, and greatly reduces the loss from leakage.

The tanks should be dustproof and should be placed low enough to permit of emptying the oil into them by gravity. If the drainage will not permit of placing the tanks below the ground level, it will generally pay to elevate the receiving track.

The tanks should be made of open-hearth steel, with lap-riveted seams, well calked. No substitute for calking, such as red lead pasté, paper felt, etc., should be permitted, for in time they will dry or crumble and fall out, leaving a leak. Before the tanks are put to use air pressure should be applied, to make



General Plan, Station for Small Town.

FIREPROOF OILHOUSES.*

The subject given us for investigation is "Plans of fireproof oilhouses for storing large quantities of oil at principal terminal stations." At terminal and division points it is necessary to carry in stock a large quantity of illuminating and lubricating oils, and it is important that these should be so stored and handled that they may not be a fire risk in themselves or be liable to become ignited from fires which originate elsewhere. It is also important that the oil be kept free from grit and foreign matter, and that the method of handling it be such as to avoid all losses from waste, leakage and evaporation.

The storage should be of sufficient capacity to permit of emptying tank cars or barrels promptly with as little labor as possible. The delivery of oil should be in charge of the regular storekeeper and be issued on requisition, so that it can be properly accounted for. This method of handling tends greatly to economy in its use. Consequently it is necessary that the oil house should be near enough to the general store to permit the delivery pumps or faucets to be in the store room; and while it is possible to pump the oil a considerable distance, it is seldom possible to place the oil house at any great distance from other buildings, as the usual layout of terminals provides very cramped space for the necessary buildings.

The committee believes that buildings can be built and systems of handling devised which will permit the oil house to be placed anywhere that may be convenient without increasing the fire risk, and several plans are shown which are good examples of such buildings.

The building itself should be of fireproof construction, designed especially for the handling and storage of oil, and should be equipped with facilities for filling cans and barrels for shipment to small stations, and for the unloading of oil received. The storage room should be underground, it possible, and should have concrete walls, floor and ceiling. The second floor and roof should be of fireproof construction. It may be of concrete, brick or steel frame, with galvanized iron roof and walls, as may be desired. The fill boxes, pumps and drip pipes should be on this second floor.

The oil should be stored in tanks of such a size as will permit of prompt unloading, whether delivered in tank cars or bar-

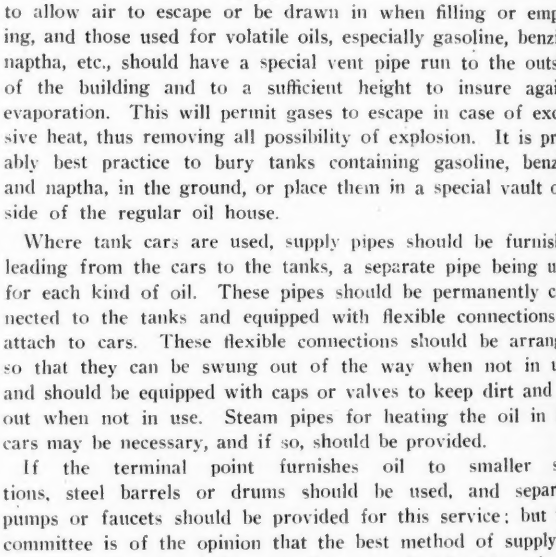
*Report of committee to the American Railway Bridge and Building Association.

sure that they are tight; and manholes with removable covers should be provided, so that the tanks can be inspected or cleaned. Indicators should be provided to show quantity contained, in gallons or otherwise.

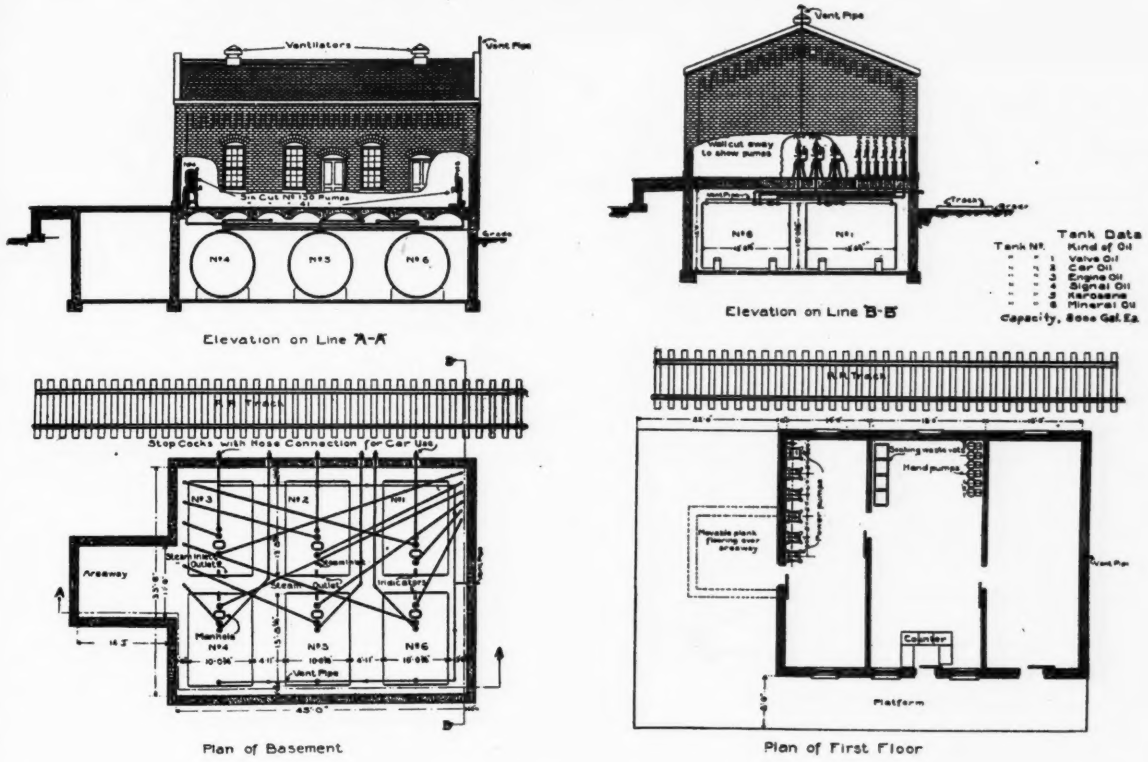
The tank should be equipped with suitable automatic vents to allow air to escape or be drawn in when filling or emptying, and those used for volatile oils, especially gasoline, benzine, naptha, etc., should have a special vent pipe run to the outside of the building and to a sufficient height to insure against evaporation. This will permit gases to escape in case of excessive heat, thus removing all possibility of explosion. It is probably best practice to bury tanks containing gasoline, benzine and naptha, in the ground, or place them in a special vault outside of the regular oil house.

Where tank cars are used, supply pipes should be furnished leading from the cars to the tanks, a separate pipe being used for each kind of oil. These pipes should be permanently connected to the tanks and equipped with flexible connections to attach to cars. These flexible connections should be arranged so that they can be swung out of the way when not in use, and should be equipped with caps or valves to keep dirt and air out when not in use. Steam pipes for heating the oil in the cars may be necessary, and if so, should be provided.

If the terminal point furnishes oil to smaller stations, steel barrels or drums should be used, and separate pumps or faucets should be provided for this service; but the committee is of the opinion that the best method of supplying oil to small stations is by a supply car equipped with tanks of sufficient capacity, and by pumping the oil through hose direct to the tanks in the local oil house. This method is in use on



General Plan, Station for Small Town.



General Plan of Oil House Containing 6 Tanks 8,000 Gals. each. Long Distance Pumps and Power Pumps for Barrel Filling.

several large roads, and they report a large saving from loss by waste and leakage, which is bound to occur in shipping oil in cans or barrels.

For making small deliveries of oil to engines, mechanics, etc., the best method is to use an automatic measuring pump, one having a continuous meter being the best. Several very reliable pumps for this purpose are on the market.

For filling barrels or large cans the oil can be handled by hand or power pumps, or by compressed air. While it has generally been believed that compressed air is objectionable for handling illuminating oils on account of deterioration caused by moisture in the air, there is a strong opinion on the part of the storekeepers and others that the use of air does not deteriorate the oil for practical purposes. Several roads use air pressure in some part of the handling of all their oils, and seem convinced that if there is any deterioration it is not to such an extent as to be noticed by the ordinary observer. Air pressure is of particular advantage in handling oil from supply cars, as the air can be taken from the train pipe, and other power is not likely to be available.

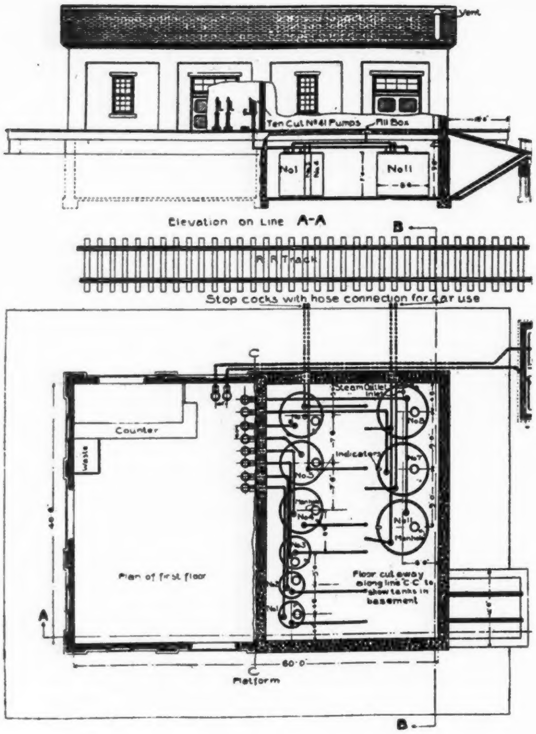
The Lehigh Valley submits the plan of a house 47x55, with concrete basement and side walls; main floor of concrete, reinforced with T-rails; wooden frame roof ¼ pitch, supported on wooden trusses, and covered with 3-ply composition granite roofing.

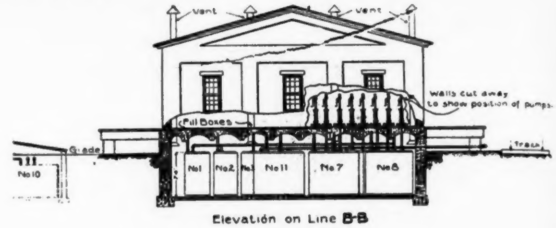
The Santa Fe sent a plan of a combination store and oil house at Topeka, Kan., 50 ft. by 150 ft., with 31 tanks in the basement, varying from 220 to 10,000 gallons capacity. It has a covered platform 20 ft. wide along one side of the building, the entire length. The house is built of fireproof materials throughout. The basement walls and floor are of concrete, and the main floor of reinforced concrete. The materials in the side walls and the roof are not described. N. M. Rice, general storekeeper, describes the system of handling oil as follows:

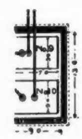
"From our new oil house at Topeka is handled the entire supply of lubricating and illuminating oils for the Santa Fe system. We have a storage capacity of 150,000 gallons, which includes paints and oils such as raw and boiled linseed oil, turpentine, etc. We have 31 storage tanks with 31 long-distance self-measuring pumps of the S. F. Bowser make. In fact, the plant complete was installed by the Bowser people. We also have seven steam pumps with which oil is transferred from one tank car to another. With one or two exceptions all oil on Santa Fe system is handled in tank car lots. We have storage tanks of sufficient capacity for two or three months' stock at practically all of our terminals.

"This new improved oil house and storage plant at Topeka enables us to transfer oil from Union Tank Line cars to our own at Topeka, thereby cutting out the mileage and per diem charges on foreign cars. Under the old system the Union Tank Line cars were sent to the farthest point on our system, Richmond, Cal., or south to El Paso and Galveston, and by the time the car was returned home we had from $25 to $35 charges covering the car. We have cut out this extra expense and have 25 cars of our own in service for handling of headlight, mineral seal, signal, engine, car and valve oil. We can transfer 200,000 gallons in ten hours at this point.

"At the outside terminals we have what is known as the combination oil and store house. We have discontinued building the old style oil houses separate and distinct from the store house. Instead, we build a concrete basement under the store house platform ranging from 20 to 100 ft. away, connected up with the Bowser long-distance self-measuring pumps, placing the pumps in the end of the store house so that the man issuing the material and supplies can take care of the oil department as well. By this arrangement we have eliminated the first cost of the oil house and have reduced the cost of handling by reason of the combination which does away with the special



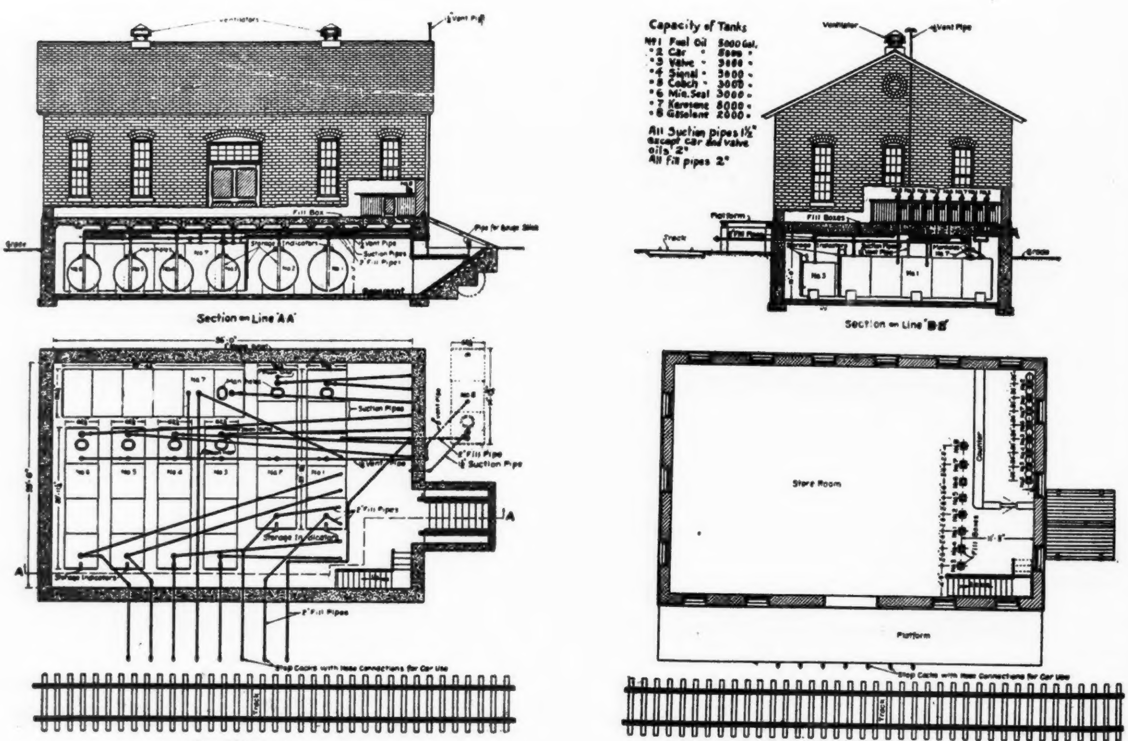




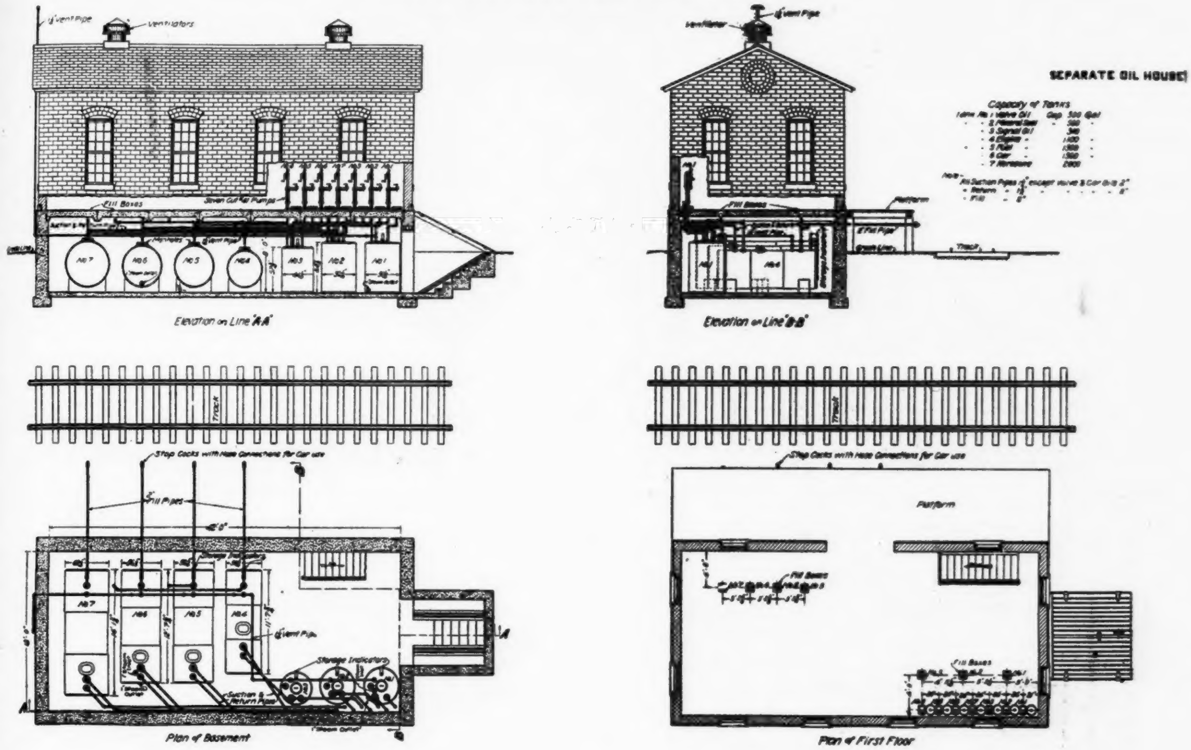
Tank Data

Tank Number	Kind of Oil	Capacity
1	Lard Oil	500 Gal.
2	Coach Oil	500 "
3	Valve Oil	1000 "
4	Signal Oil	2000 "
5	Mineral Seal	2000 "
6	Engine Oil	2000 "
7	Headlight Oil	3000 "
8	Car Oil	3000 "
9	Gasolene	1000 "
10	Hydro Carbon	1000 "
11	Car Oil	3000 "

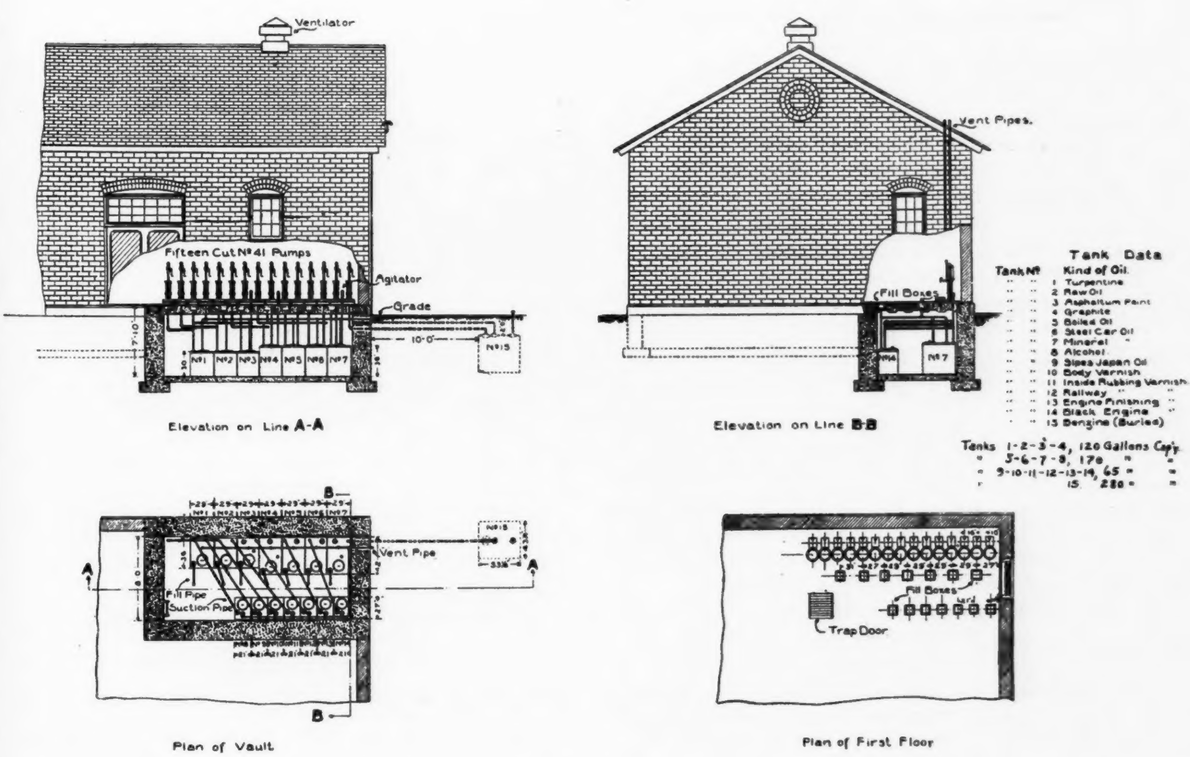
General Plan of Oil House Containing 11 Tanks. Gasoline and Hydro-Carbon Tanks Buried Outside.



General Plan of Oil House Containing 8 Tanks. Gasoline Tank Buried Outside.



General Plan of Oil House Containing 7 Tanks in Basement.



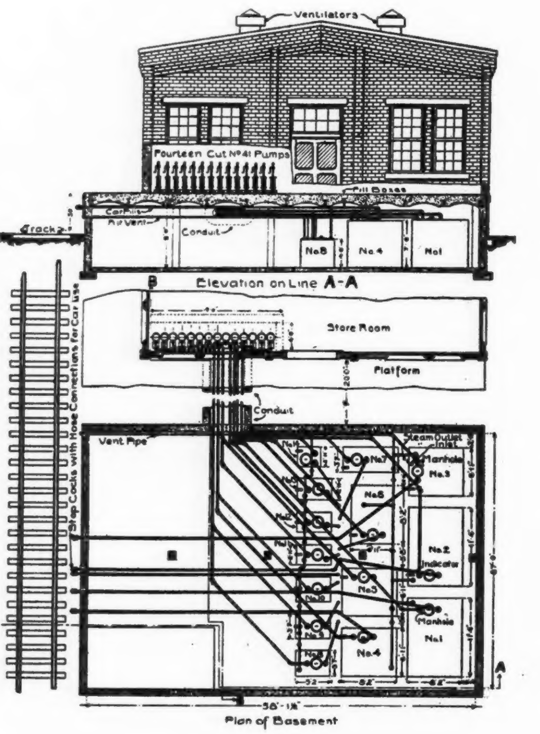
General Plan of Oil House Containing 15 Tanks, 65 to 280 Gals. Capacity. Gasoline Tank Buried Outside.

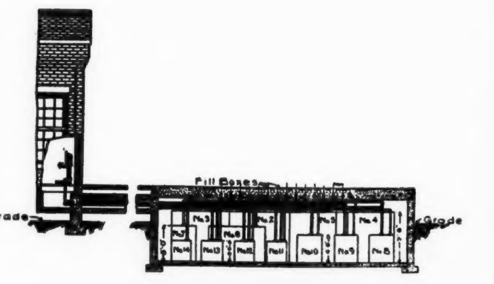
men that would have to be employed to take care of the oil house, which means one during the day and one at night. We might say from $90 to $100 per month decrease in handling by reason thereof.

"The delivery of oil to stations is handled from the supply car direct. We have storage tanks at each station based on their issues, and the stock is replenished monthly from the supply car, which is equipped with a hose connection, so that we can fill

Tank Data

	Kind of Oils	Capacity
Tank No. 1	Car Oil	5000 Gal.
" " 2	Headlight Oil	5000 "
" " 3	Valve Oil	3000 "
" " 4	Coach "	3000 "
" " 5	Mineral Seal	3000 "
" " 6	Signal Oil	2000 "
" " 7	Boiled "	1000 "
" " 8	Sipes Japan	500 "
" " 9	Turpentine	500 "
" " 10	Common Black	500 "
" " 11	Dynamo Oil	300 "
" " 12	Paraffine	300 "
" " 13	Black Enamel	300 "
" " 14	Black Varnish	200 "





Elevation on Line B-B

General Plan of Oil House Containing 14 Tanks in Concrete Vault or Basement 20 Feet from Building. Oil is Drawn by Long Distance Pumps.

the storage tank in two or three minutes. By this system we do away with the two, five and ten-gallon cans. This system seems to be very satisfactory, indeed, by reason of cutting out local shipments entirely.

"We have the Bowser system of self-measuring and metering pumps at all points and since their installation we have been able for the past two years to show a slight excess in each of the different grades of oil. Prior to this time we were, at the end of each year, from one to three per cent short."

The Intercolonial furnished a plan of an oil house at Halifax, 30 ft. by 50 ft., of fireproof construction throughout. The basement floor and side walls are concrete; main floor, reinforced concrete 4½ ins. thick, supported on 15-in. I-beams; side walls of main room, brick; roof of 3½-in. reinforced concrete slabs on 9-in. I-beams, pitched both ways from middle, 1 in. to 1 ft.; height of basement, 9 ft.; height of main room, 10 ft. This building has two center columns, composed of I-beams.

The Rock Island sent in a very neat and elaborate set of detail drawings of their No. 2 oil house, 20x40 ft.

The St. Louis Southwestern has a brick oil house built as follows: Size, 30x80 ft.; basement walls, concrete; composition roof laid on 2-in. decking, supported on 2x4 nailing strips, on top of 7-in. longitudinal channels which are laid across riveted steel trusses, having no center bearings. The roof trusses are 16 ft. and the channel supports about 3 ft. 6 ins. apart.

The Missouri, Kansas & Texas has an oil house at Denison, Tex., 32x42 ft., after the same general design as that of the St. L. S.-W., described above, except that the roof is built up of wood, and covered with tar and gravel or composition roofing.

The Chicago & Northwestern has a number of oil houses built of brick on concrete foundations, with tar and gravel roof supported on a wood decking laid over wooden rafters. These houses are built separate and a short distance from the store houses, connected with a concrete conduit which contains the pipes leading from the oil tanks in the basement of the oil house to the store room, where long-distance pumps deliver the oils.

Attention is called to the fact that some of the plans submitted do not comply strictly to the term "fireproof," having more or less wood in the construction of the roof. While the M., St. P. & Ste. M. house is of that character it has a sheet-iron protected ceiling which reduces the fire risk to a very great extent.

Forest fires which developed about October 7 wiped out several towns on the Canadian Northern near Rainy river, Ont. The greatest loss was in Minnesota east of Rainy river. At last reports the fires were still burning in a region about 85 miles long and 35 miles wide. Estimates as to the loss of life run from 75 to 400 people. The railway seems to have been kept open.

The Pensacola, Mobile & New Orleans will carry out with its own men the work on the trestle over the Apalachee river on the line under construction from Pensacola, Fla., northwest to Mobile, Ala., 60 miles. Contracts will be let in about six months for the draw and fixed spans of the bridge to be built in connection with the trestle. Grading work is now under way and it is expected will be finished by the end of 1910.

Contracts are to be let at once to build the Nueces River Valley from Beeville, Tex., west via Clareville, Simmons City, Tilden, Cotulla and Carrizo Springs to Eagle Pass, about 180 miles. Maximum grades will be 1 per cent, maximum curvature 2 degs. The plans call for building three steel bridges, a roundhouse, turn table, machine shops and buildings for general offices. The line will carry coal, live stock, wood, quarry products, cotton and grain. W. A. Frisby, president; G. A. Hull, consulting engineer, Beeville.

CONVENTION OF THE RAILWAY SIGNAL ASSOCIATION.

The 15th annual convention of the Railway Signal Association was held at Hotel Jefferson, Richmond, Va., October 11 to 13. The attendance was good, about 400 members and guests being present. President H. S. Balliet presided, C. C. Rosenberg, secretary-treasurer, was unable to attend. Mayor Richardson, of Richmond, delivered the address of welcome, referring, among other things, to the historic attractions about the city. The mayor concluded by saying that next to soul-saving institutions, life-saving organizations were the most important.

In the president's annual address Mr. Balliet commented on progress made in signaling. The mileage of railroad operated under block signals has been increasing rapidly, the total length now being upward of 65,000 miles, according to Mr. Balliet. The report of the secretary showed the membership to be 1,193. Receipts from all sources during the year were $8,281.35 and the balance on hand $2,405.64.

The first matter considered was the proposed amendments to the constitution, to be voted upon by letter ballot later in the year. One was a proposition to change the dividing line between the eastern and western sections, which heretofore has passed through Buffalo, Pittsburg, and down the Ohio and Mississippi rivers, so as to bring it through the middle of Lake Michigan, and thence along the eastern boundary of Illinois to the Ohio River. C. C. Anthony, Pennsylvania, pointed out that such a change would divide the membership quite unequally. There was a good deal of discussion, and the consensus of opinion was that the dividing line should be abolished altogether.

Another proposition was to hold the annual meeting each year in Chicago, in March, the point of advantage being the opportunity to see the exhibit of appliances prepared for the annual convention of the American Railway Engineering and Maintenance of Way Association. One of the drawbacks would be the difficulty for those who are members of both associations to see the exhibits without spending nearly the whole week in Chicago or absenting themselves from some of the sessions. It was voted that the date of the annual convention should not be changed from that now provided by the constitution. As to the place for the annual meeting it was the opinion that the welfare of the association could best be promoted by changing the place from year to year, so as to cover the country broadly and thus give members in widely separated parts opportunity to attend during some of the years without traveling far.

Mechanical Interlocking.

The report of Committee No. 2, on mechanical interlocking, was discussed at length. The committee had been instructed to continue the investigation and report in detail the comparative advantages of using pipe-connected home signals without slots, pipe-connected slotted signals and power signals at mechanical interlocking plants. After careful investigation the committee deemed it advisable to divide the subject into two classes, as follows:

Class 1—Home signals that are not required to return to the stop position automatically.

Class 2—Home signals that are required to return to the stop position automatically, and at locations where mechanically operated home signals are not practicable.

The conclusions presented by the committee were adopted by the convention for submission to letter ballot in the following amended form:

1st—That pipe-connected home signals be used at points where the automatic return to normal position is not required, except at locations where special conditions exist, where the installation, maintenance and efficiency of operation make the power type preferable.

2nd—That power-operated signals be used at mechanical interlocking plants at points where three-position signals are required to return to the stop position automatically, and at points where three-position automatic block signals are in use, or are contemplated.

The committee had also been instructed to investigate and advise with full abstract of vital points discussed, and report to the association on methods of insuring the return to the normal position mechanically-operated distant signals.

The committee reported that it was unable to suggest any means of insuring the return to normal position of any signal, but recommends an electric lock so arranged as to prevent the return of home signal lever latch to normal position except when the circuit is completed through springs on the distant signal in normal position.

The report on this subject was ordered submitted to letter ballot.

The committee had also been instructed to investigate and report the result of comparison, with recommendations of the American Railway Engineering and Maintenance of Way Association practice for making concrete as applied to signal and other foundations for signal work.

The committee reported that it had found the specifications of the Railway Signal Association for concrete very incomplete, covering only the density proportion, based on one to nine. It was therefore deemed advisable to formulate a complete set of specifications to conform to A. R. E. & M. W. Assn. specifications for concrete, which was done. After discussion it was noted that these specifications should be compared with those of Committees 2, 3 and 4, and resubmitted, with a view to adopt a single specification for concrete used in work covered by the three committees.

Subjects "e," "f" and "g" are given below, together with the report of the committee in each case. These were received as progress reports.

Subject "e."

Submit a list of comparative arithmetical values to be given to those operated units to which the committee's work is confined, based on an arbitrary value of ten (10) for one-arm, three-position power-operated signals.

Considerable time has been given to discussing this, and the committee had secured considerable data relative to the average distance of functions, etc., but is unable to submit a list of values whereby an interlocking plant could be divided on the unit basis.

Subject "f."

Prepare specifications for wrought iron pipe.

This subject was fully discussed at the New York meeting and the chairman had met with Committee No. 1 and agreed upon the specifications which sub-committee on standards had submitted to the association.

Subject "g."

Confer with sub-committee on standards.

The chairman had met with sub-committee on standards at one meeting, and the work in connection with association standards had been actively carried on through correspondence.

Power Interlocking.

The report of Committee No. 3, on power interlocking, was presented in the form of reports of sub-committitess, as follows:

Sub-Committee "A"—Electric Bolt Lock.

Sub-Committee "B"—Circuits.

Sub-Committee "C"—Wire Protection in Underground Trunking.

Sub-Committee "D"—Comparative Arithmetical Values.

Sub-Committee "E"—Specifications for Electro-Pneumatic Interlocking.

The recommendations and conclusions of the report were as follows:

1. The printed specifications in Volume 12, No. 4 Journal, December, 1909, show the specifications of the committee as ordered at last annual meeting.

2. The committee recommended the methods submitted by Sub-committee "A" under clause (e) as desirable additional safety devices and recommended to the executive committee that they are worthy of practical development.

3. Under clauses (b) and (c) of the instructions the committee has been unable to find in service specific installations of an electric bolt lock.

4. The committee recommended that the typical circuits for one-arm signal and signal switch as shown by Sub-committee (B) be received as information and that the investigation be continued.

5. The committee report progress on the investigation as to typical circuit for selecting signals.

6. The committee submitted as information one typical circuit showing a practical method of substituting a detector circuit for bars and reported progress in the investigation of other circuits for a similar purpose.

7. The committee submitted the report on practicable methods of route locking, together with seven typical circuits as information and recommended further investigation of the subject and also investigation of approach locking.

8. The committee recommended the adoption of the specifications for underground trunking, pitch and methods of installation as the standard of the association.

9. The committee recommended the arithmetical values of operated units as submitted, subject to conference as to relative values submitted by other committees.

10. The committee submited reports on concrete foundations as information.

11. The committee submitted the specifications for electro-pneumatic interlocking, together with memoranda by Sub-committee "E" as to suggested changes in former specifications as a progress report and asked that it be referred back to the committee for further investigation, including subjects (d), (dd) (g) and (i).

12. The chairman of the committee attended various meetings of Sub-committee No. 1 on Standard Designs. The chairman of sub-committees had conferred with the chairmen of Sub-committee No. 1 as to proposed standard drawings. It had been recommended that the chairmen of Committees 2, 3 and 4 could best meet and harmonize any slight details of the specifications for automatic block work after the report of Committee No. 4 of this year had been submitted to and criticised by the association in annual convention. Such conferences were ordered by the executive committee in instructions to this committee (n) and instructions to Committee No. 4 (c).

Discussing the report on underground trunking, Mr. B. H. Mann said that the committee had feared that a compound could not be obtained which would prove to be a durable protection for underground wires in all conditions. J. M. Waldron, Interboro, replied that there could be no doubt on this point. He had used such a compound during the past two years and found it entirely satisfactory for the purpose.

As the result of discussion the drawing for proposed circuits for an electric bolt lock, submitted by Sub-committee A, and that of Sub-committee B for typical detector circuits for power interlocking were accepted as information.

Promotion of Signaling Education.

The report of the special committee on promotion of signaling education was presented by the chairman, W. J. Eck, Southern. Among other things, this report includes a lengthy index to signal literature, that was much appreciated and the many expressions of approval were highly creditable to Mr. Eck. The report was received as information and ordered printed and bound as a separate publication, to be sold to members at cost. The report contains 183 pages.

A vote of thanks was extended to Mr. Eck for his great labor in preparing this report, and also to his wife, who assisted him in the work.

Signaling Practice.

Committee No. 1, on signaling practice, had been instructed to—

1. Bring up to date all literature and actions suggested or ordered at the last meeting.

2. Report on advisability of upper left-hand quadrant signals.

3. Develop to conclusion the subject of uniform signaling.

4. Prepare new standards.

5. Harmonize specifications.

Subject No. 1 is covered by the work done on Subjects No. 3 and 4.

On Subject No. 2 the committee recommended the submission of its report to letter ballot in the following concrete form: "The Railway Signal Association, while not condemning upper left-hand quadrant signals, recommends the use of upper right-hand quadrant signals for new work and renewals."

The report on this subject was adopted, as submitted, and will go to letter ballot in that form.

On a system of uniform signaling, which has been such a lively subject for several years past, the committee reported progress, and the report was accepted on this basis. The report on this subject follows:

"The letter ballot in last year's report rejected so emphatically the propositions advanced that the committee was somewhat at a loss as to future procedure. The fundamental differences, in the viewpoints of the majority and minority, were so pronounced that a unanimous report this year seemed out of the question. Our report, as is the custom, was submitted by Committee No. 10 of the American Railway Engineering and Maintenance of Way Association as its report to that body in March, together with a minority report signed by four members. After considerable discussion it was referred back to the committee, with instructions to confer with the proper committee of the American Railway Association, for decision. The president of the Maintenance of Way Association arranged such a conference, which was held at Niagara Falls on June 8. After a hearing, lasting about two hours, the committee on transportation appointed a sub-committee of three thoroughly to investigate the matter and report its findings to the entire committee, with the understanding that that committee would later advise us what, in their opinion, were the signal indications necessary for proper railroad operation. Our work, on receipt of this report, will, of course, be to recommend to the Maintenance of Way Association the aspects for the display of such indications, and we ought to be able to present a unanimous report. Meanwhile, with the conditions prevailing, we have no option but to report progress on Subject No. 3."

On Wednesday the convention continued the consideration of the report of Committee No. 1 as to standards. Under subject No. 4 drawings were presented, with recommendations, for submission to letter ballot as standard. They were submitted in 1909 and accepted by the association as a progress report. These drawings covered:

Semaphore Spectacle, Design "A"
Semaphore Spectacle, Design "B"
Spectacle Rings.
Two and Three-Arm Signal, Complete.
Two and Three-Arm Bracket Signal, Complete.

They were received without discussion and ordered submitted to letter ballot.

The following drawings, which had been approved by Committee No. 1, and had also been accepted by the association, after discussion at stated meetings, either in New York or Chicago, were again presented with recommendation that they be submitted to letter ballot.

Ladders for Ground Masts (Mechanical Signals).
Ladders and Stays for Ground, Bracket and Bridge Masts (Mechanical Signals).
Ground Signal Masts for Power Signals with Mechanism at Shaft and for Mechanical Signals.
Base for Bracket and Bridge Signal Mast (Cast Iron).
Bracket Post and Bridge Signal Masts for Power Signals with Mechanism at Semaphore Shaft and for Mechanical Signals.
Lamp Bracket.
Pinnacle.
Pinnacle for General Electric Co. and Hall Signal Co. Top Mast Mechanisms.
Ladder Foundation.
Terminal Block (Porcelain).
Nut and Washer for Binding Post.
Concrete Foundation for Pipe Carrier.
Semaphore Lamp and Specifications.
Lamp Equipment and Specifications.

All of these were ordered submitted to letter ballot except the drawing and specifications for a standard semaphore lamp. The principal point of discussion was the diameter of lens. The drawing submitted with the report showed a 5-in. lens, and the question was raised as to the relative efficiency of a lens of this diameter. A. G. Shaver, C., R. I. & P. is using 5⅜-in. lenses, and F. P. Patenall, B. & O. 6-in. lenses, in semaphore lamps. Dr. Churchill, widely recognized as an expert on such matters, being called upon, said that for any given focal distance there was one correct diameter of lens. For a lamp body of 3½ ins. radius, such as the committee had shown, the correct diameter of lens was 5⅜ ins. The difference in efficiency, as compared with the 5-ins. lens, was 15 per cent in favor of the 5⅜-ins. lens. As the result of an investigation, and taking all colors of lenses into consideration, he had found that the number of 5⅜-in. lenses bought outnumbered the 5-in. lenses by 50 per cent. B. H. Mann, Mo. P., called attention to the importance of flame spreaders for long-time burners. On this point Dr. Churchill said that the modern long-time burner gives a flat flame, spread to ½ in. or wider, and of nearly one candle power, and the full power of the light spreads to 150 ft. in 1,000 ft. of distance. These results compare with a round flame of about ¼ candle power, spreading the full intensity of the light only 50 ft. in 1,000 ft. of distance. The consumption of oil in the modern long-time burner is scarcely twice that of the old-style round flame burner, and the lining up of the light with the lens is much easier accomplished with the modern flat flame. With the old round flame there is a leeway of only about 1 deg., and it is doubtful if with such burners any considerable percentage of lights, under ordinary conditions, are lined up to give the full power of the light in the direction of the track.

It was finally voted that the drawing and specifications be submitted to tentative letter ballot, to determine the preferences of the different railroads as to the size of lens.

C. H. Morrison, N. Y., N. H. & H., suggested that a drawing should be submitted by the committee to show bridge

Members and Guests of the Railway Signal Association at Richmond, Va.

signal masts suspended, as from the bottom chord of a highway bridge over a deep cut; and Mr. Shaver suggested still another drawing showing standard bridge signal masts with mechanism at the foot of the mast.

The committee submitted as a progress report, the following drawings, with the request that they be discussed by the association:

Ladders for Bracket and Bridge Masts (Mechanical Signals).

Base for Bracket Post.

Bracket Post (Using Pipe for the Main Stem).

Bracket Post (Using Lattice Construction for Main Stem).

Ladders for Ground Masts for Power Signals with Mechanism at Shaft.

Ladders for Bracket and Bridge Masts for Power Signals with Mechanism at Shaft.

Details of Ladders for Power Signals with Mechanism at Shaft.

Details of Ladders, Platforms, Handrail and Stays for Power Signals with Mechanism at Shaft.

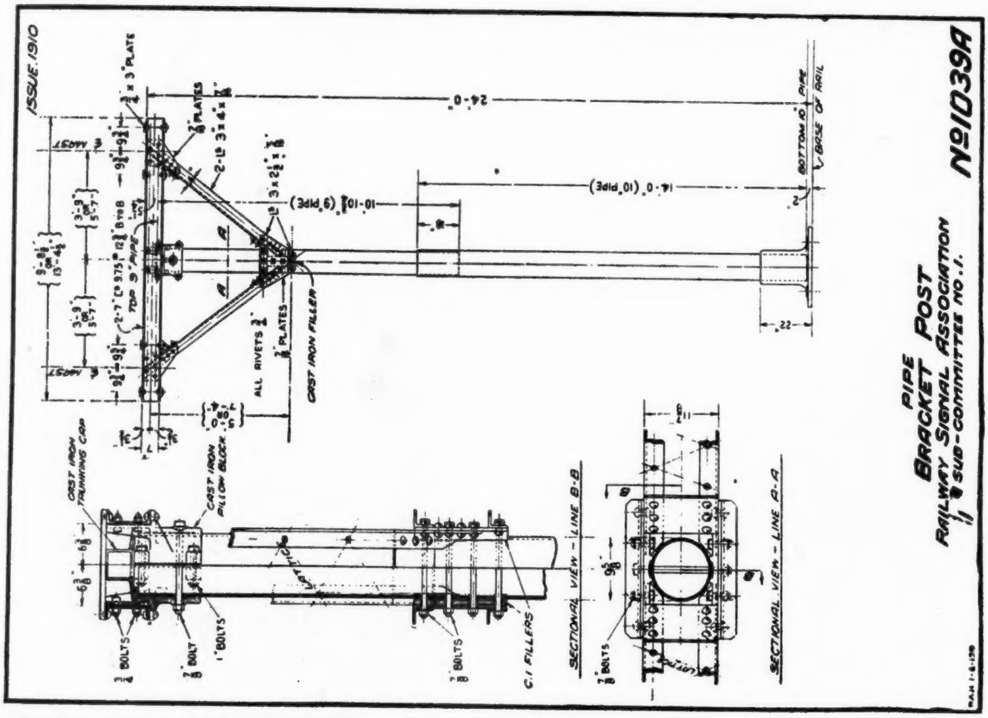
Deck for Bracket Post.

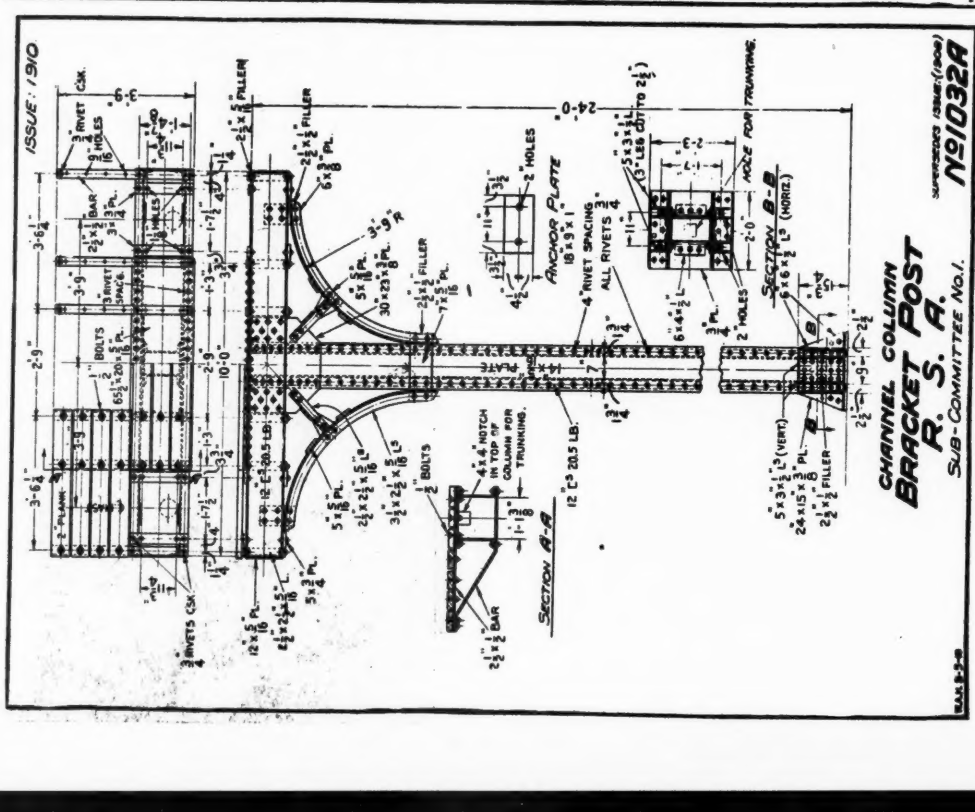
Platform for Bracket Post Deck.

Dwarf Signal Sketches.

Semaphore Bearings.

"U" Bolt and Clamp for Semaphore Bearing.

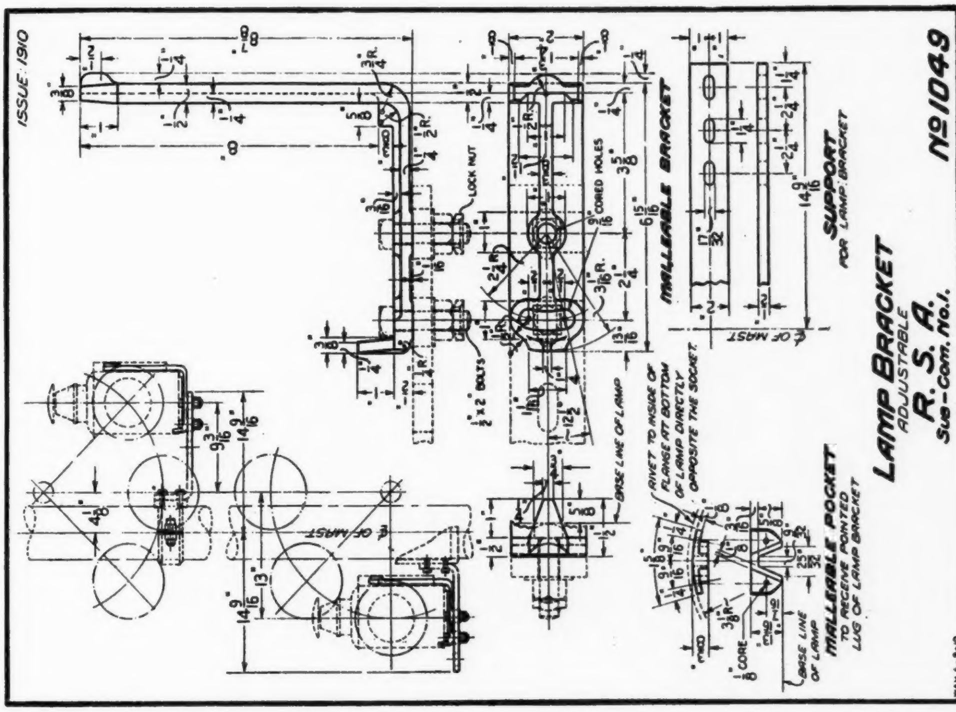


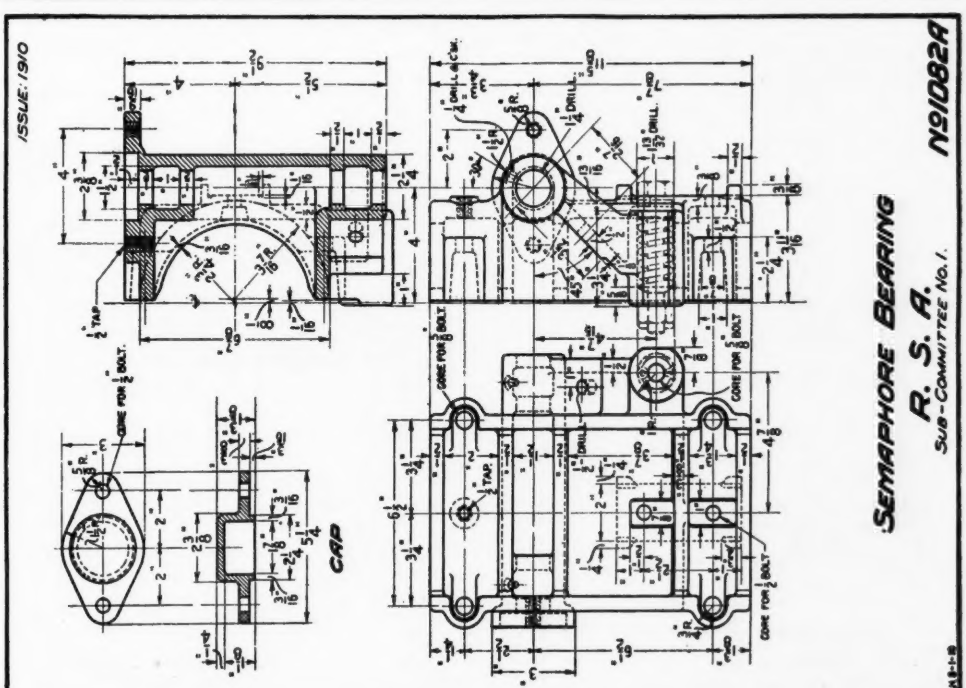


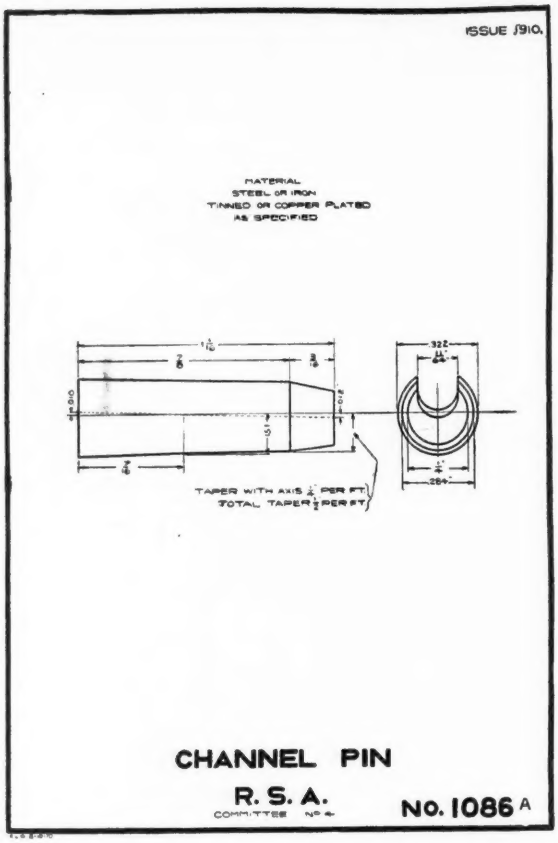
The drawing for a dwarf signal, was presented because the committee believed it was necessary to have some discussion on this subject. The problem to be worked out is to get a design of dwarf signal that will permit the passage of the largest Mallet compound engine over tracks with 12-ft. 2-in. centers. The committee believed it to be important to have a standard, as it is quite likely that some signal engineers would rather have two designs than one which must be small enough to meet the clearance conditions, as shown. If the association would decide this point, the committee would present to it drawings to be approved as standard.

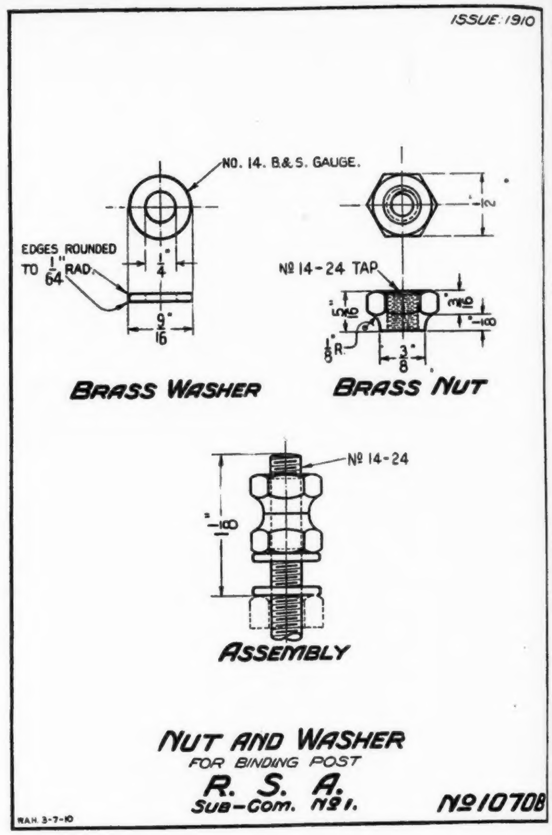
In the discussion several expressed themselves in favor of two designs—one for usual conditions and another for tracks at 12-ft. centers. Others thought the smaller design should not be used unless the clearance conditions actually required it, as the light for it was undesirably small.

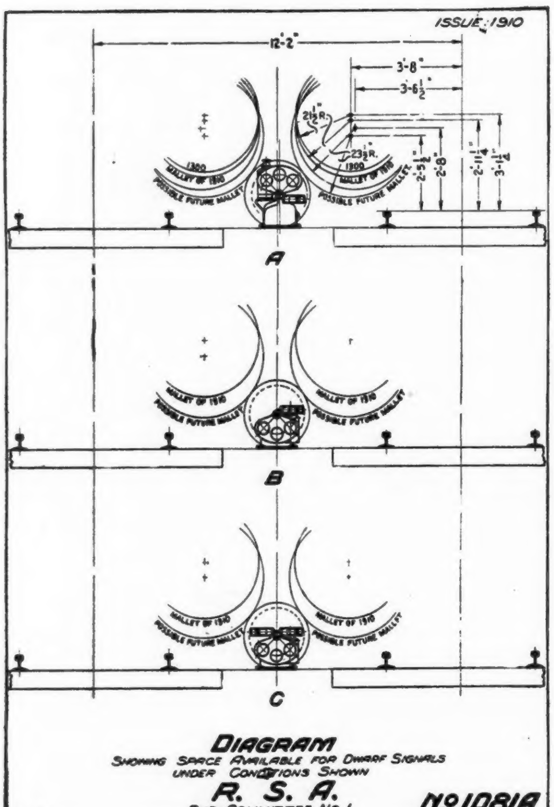
The committee was instructed to prepare two designs, accordance with the requirements made known in the discussion. The discussion brought out the fact that the shipment of Mallet compound locomotives to certain roads, the Pennsylvania for one, had required the taking down of dwarf signals along parts of the route over which these locomotives had been hauled to destination.

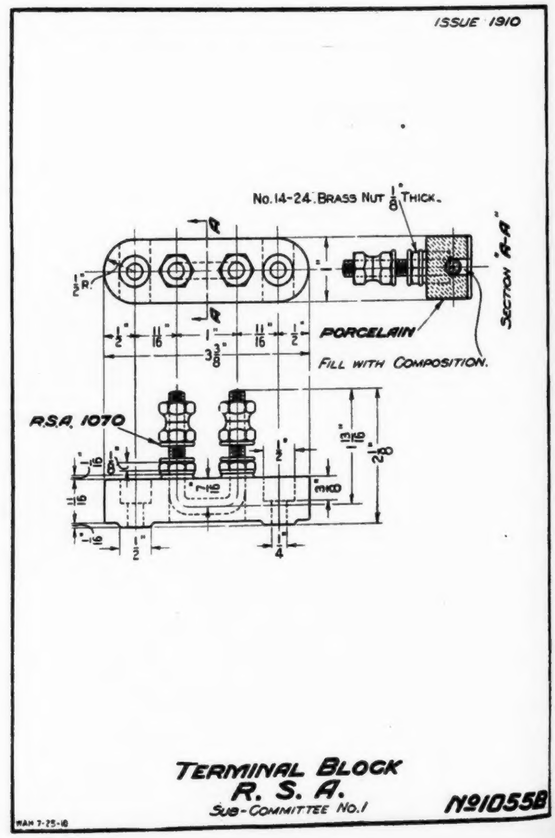




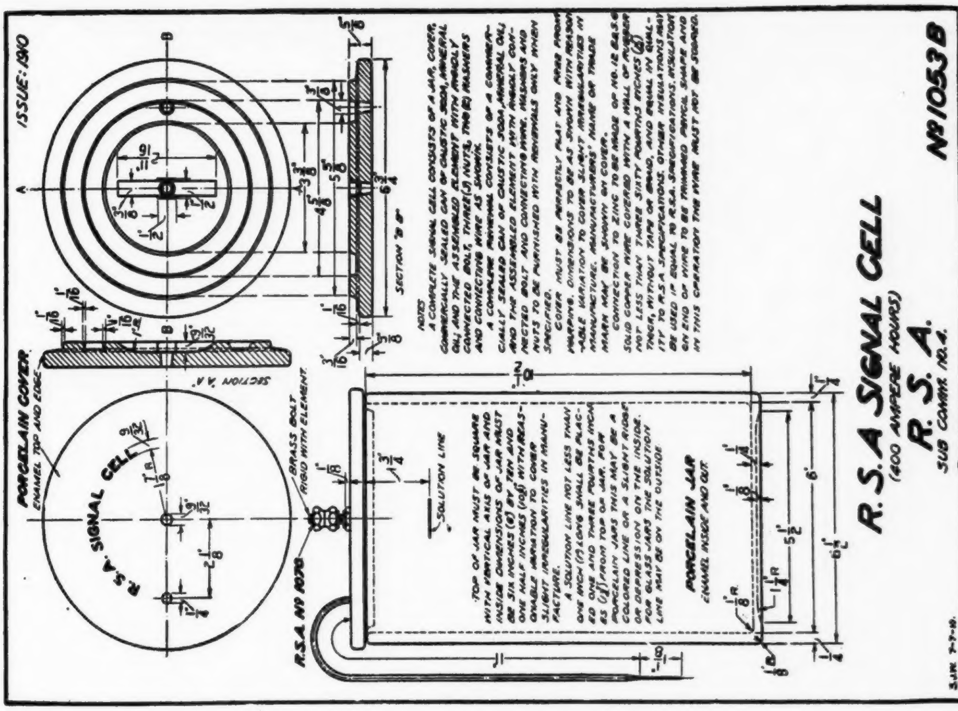

ISSUE 1910.
MATERIAL
STEEL OR IRON
TINNED OR COPPER PLATED
AS SPECIFIED
TAPER WITH AXIS ¼" PER FT.
TOTAL TAPER ½" PER FT.
CHANNEL PIN
R. S. A.
COMMITTEE No. 4.
No. 1086 A


ISSUE 1910
NO. 14. B.&S. GAUGE.
EDGES ROUNDED TO 1/64" RAD.
Nº 14-24 TAP
BRASS WASHER
BRASS NUT
Nº 14-24
ASSEMBLY
NUT AND WASHER
FOR BINDING POST
R. S. A.
SUB-COM. Nº 1.
Nº 1070B


ISSUE 1910
12'-2"
3'-8"
3'-6½"
MALLET OF 1910
POSSIBLE FUTURE MALLET
A
B
C
DIAGRAM
SHOWING SPACE AVAILABLE FOR DWARF SIGNALS
UNDER CONDITIONS SHOWN
R. S. A.
SUB-COMMITTEE No. 1.
Nº 1081A


ISSUE 1910
No. 14-24. BRASS NUT ⅛" THICK.
SECTION "A-A"
PORCELAIN
FILL WITH COMPOSITION.
R.S.A. 1070
TERMINAL BLOCK
R. S. A.
SUB-COMMITTEE No. 1
Nº 1055B

RAILWAY ENGINEERING AND MAINTENANCE OF WAY.



Automatic Block.

On the report of Committee No. 4, Automatic Block, the following action was taken:

Detail specifications for material, and specifications for direct current low-voltage electric motor semaphore signals were adopted for submission to letter ballot.

The specifications for direct current relays for steam roads caused a good deal of discussion and proved to be unsatisfactory in some respects to several of the members. (These specifications were published in our issue of July). It was finally voted that they should be referred back to the committee for further consideration.

The specifications for tinned channel pins were corrected as to certain details and adopted for submission to letter ballot. The standard pin shown by this report is $1\frac{1}{16}$ ins. long. F. P. Patenall said that he had found it desirable to increase the length of channel pins to $1\frac{5}{32}$ ins., in order satisfactorily to fit webs of increased thickness in some of the recently designed rail sections.

The specifications presented for a standard caustic soda primary battery signal cell were amended as to one or two minor details and then adopted for submission to letter ballot, providing that in the meantime the manufacturers would submit to the secretary a written statement waiving patent rights that may be covered or infringed by features in the design submitted. The discussion showed a preference for a thumb screw or winged nut to the ordinary nut for cell binding posts, and the design was ordered corrected to cover that feature.

The specifications for wood trunking were ordered submitted to letter ballot.

Electric Signaling for Electric Roads.

The report of Committee No. 10, on electric signaling for electric railroads, covers the subject quite extensively, including a history of the art, and it was accepted as information.

Automatic Stops and Cab Signals.

Committee No. 6 submitted a report on automatic stops and cab signals which was received as information as to historical data and discussion, but the requisites of installation, in slightly amended form, were ordered submitted to letter ballot.

In the discussion Azel Ames said that he had recently seen a system of automatic stops where the removal from the roadbed of a contact rail or trip would have the effect of setting the brakes. This result was accomplished by a time-interval mechanism. He regarded the system as worked out on a new idea in automatic stops and thought that in future work the committee should take recognition of the idea.

Subjects and Definitions.

Committee No. 7, on subjects and definitions, submitted definitions as follows:

Blade-grip: That part of the semaphore arm or spectacle which is formed to receive the blade and to which the blade is fastened.

Blade: That extended part of the semaphore arm which is used to make distinct and conspicuous the positions of the arm.

These definitions were ordered submitted to letter ballot.

The election of officers resulted as follows:

President, C. E. Denney, L. S. & M. S.

First vice-president, C. C. Anthony, Pennsylvania.

Second vice-president, B. H. Mann, Missouri Pacific.

Secretary, C. C. Rosenburg.

Members of executive committee, Frank P. Patenall and A. G. Shaver.

Colorado Springs, Colo., was selected as the place for holding the annual meeting in 1911.

The first matter of business taken up on Thursday was the report of Committee No. 9, on Wires and Cables, presented by the chairman, W. H. Elliott, New York Central. This report covered the following items:

Revised specification for double-braided, weatherproof, hard-drawn copper line wire.

Revised specification for rubber insulated signal wire for current 600 volts or less.

Specification for aerial braided cables for current of 600 volts or less.

Revised specification for galvanized E. B. B. iron bond wires.

Revised specification for double-braided, weatherproof, galvanized B. B. iron line wire.

Specification for rubber-insulated, lead-covered, armored submarine cable for 660 or lower voltage service.

Specification for double-braided, weatherproof, hard-drawn, copper-clad, steel line wire.

In many places changes had been introduced since the printing of the report, which Mr. Elliott said were only of minor consequence, but which, nevertheless led to considerable discussion. Mr. Langan was of the opinion that some of these changes (especially in the table of resistance) were of a radical nature, and he regretted that the committee, after much study, had printed the results of its investigations only to change them at the last moment before the calling of the convention.

The whole report, with amendments covering Mr. Elliott's minor changes, was ordered submitted to letter ballot.

The report of the special committee on storage batteries was received as information and the committee was instructed to pursue the subject for further report.

The report of the special committee on methods of recording signal failures was accepted in somewhat modified form for submission to letter ballot.

A motion was put and carried authorizing the executive committee to appoint a committee to formulate rules for the guidance of signal maintainers.

Committee No. 5, on manual block, and the special committee on lightning arresters presented progress reports only.

The selection of the place for holding the annual convention next year ended the work of the convention.

The exhibitions of signal appliances were fewer than in years past, quite likely because of the limited space available for the purpose. Nevertheless, the Signal Appliance Association was in evidence, particularly in arranging for the entertainments, the principal events of which were as follows:

Luncheons at Hotel Jefferson at 1 p. m. on Tuesday and Wednesday. Informal dance at Hotel Jefferson on Tuesday evening. Automobile ride for the ladies about the city and suburbs of Richmond during the forenoon of Wednesday. Fifth annual dinner at Hotel Jefferson on Wednesday night. The governor of Virginia was present at this dinner and took a prominent part in the speaking.

On Thursday there was a street car ride for the ladies, during the forenoon, and an oyster roast and baseball game between eastern and western members during the afternoon The whole assemblage took some part in these latter events, aided by a brass band.

On Friday, Oct. 14, the members and friends took a special train via Chesapeake & Ohio Ry. for a visit to Williamsburg and Old Point Comfort, lunching at Hotel Chamberlain and returning to Richmond in the evening.

Railway Signal Standards No. 12, The Chicago, Milwaukee & St. Paul.

This road has lately adopted three position, upper quadrant signaling. Formerly signals gave two indications in the lower right hand quadrant. Automatic block signal blades are painted red with a white stripe on the front and white with a black stripe on the back. Night color indications are red for stop, green for caution and white for clear. The spectacle is practically Railway Signal Association standard like that shown in Fig. 179. Some signals are lighted by electricity, and when this is done the lamp and fittings shown in Fig. 266 are used.

Signals are operated by 16 cells of potash battery housed in concrete wells. Line circuits are fed from a separate battery of six cells potash. Polarized line circuits are used, Figs. 267, 268, 269, 270. The last three are continuous with each other and show some special circuits involving an interlocking plant. They illustrate methods of slotting power operated signals, electric locking, indicator and annunciator circuits.

Track circuits are fed from two or three cells of gravity battery housed in chutes, Fig. 271. Track circuits are taken through switches in a manner very similar to that shown in Fig. 40. Insulated rail joints are of the angle bar type.

Switch indicators are provided at all uninterlocked switches and the following rule applies:

"Switch indicators will in all cases face the switch stand, so that person operating switch will face indicator dial. Indicator will never exceed in height the switch stand to which it is adjacent. Where derail on siding is not operated from main track switch stand, indicator will be placed at derail."

Fig. 272 illustrates method of tagging wires. The following system of numbering is employed:

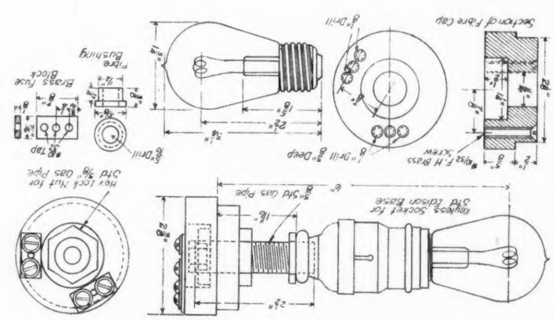


Fig. 266. Electric Lamp and Fittings for Semaphore Lantern. C. M. & St. P.

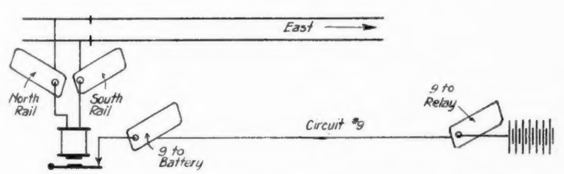


Fig. 272. Method of Tagging Wires. C. M. & St. P.

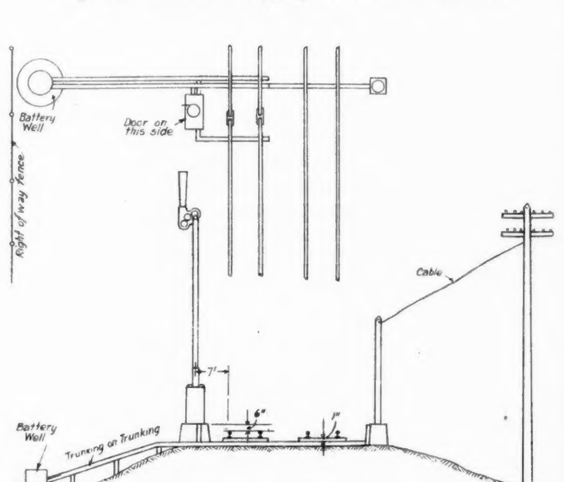
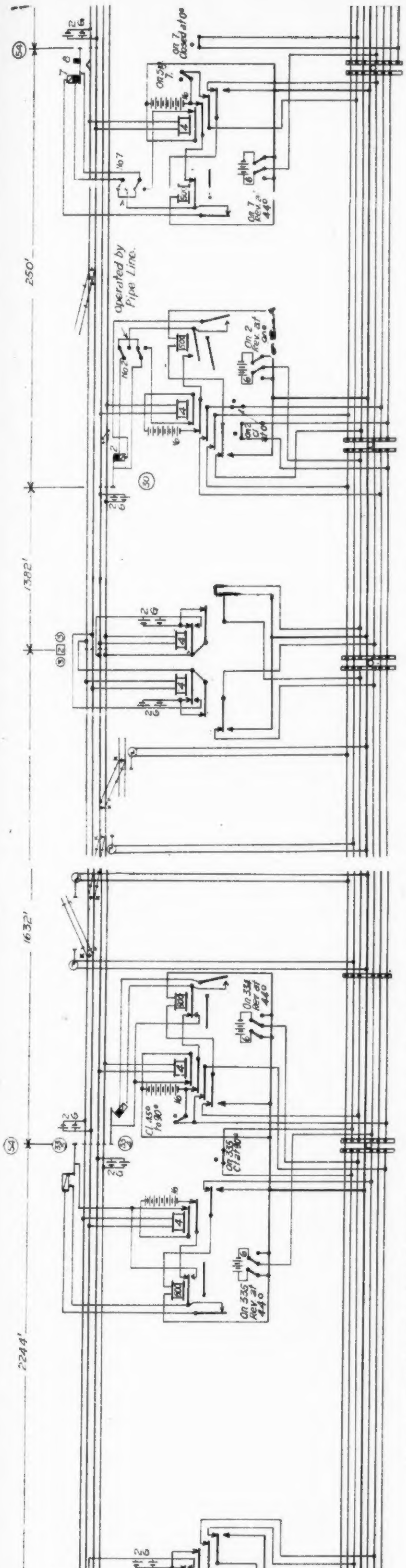


Fig. 273. Layout of Apparatus at Signal Location. C. M. & St. P.



Figs. 268, 269. Special Circuits for Automatic Block Signals, Switch Indicators, Semi-Automatic Signals and Electric Locking. C. M. & St. P.

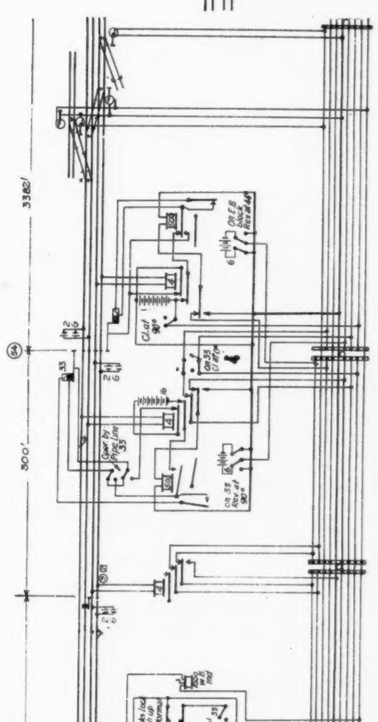


Fig. 270. Continuation of Fig. 269.

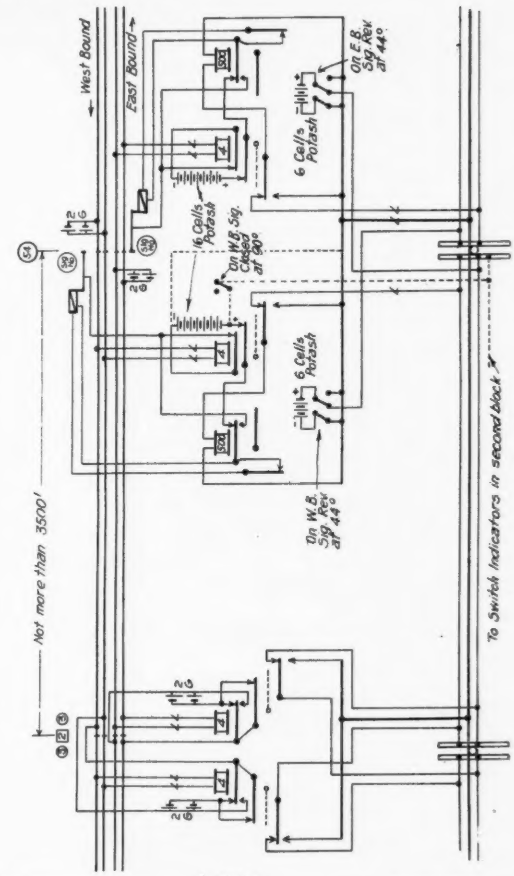


Fig. 267. Typical Circuits for Automatic Block Signals on Double Track. C. M. & St. P.

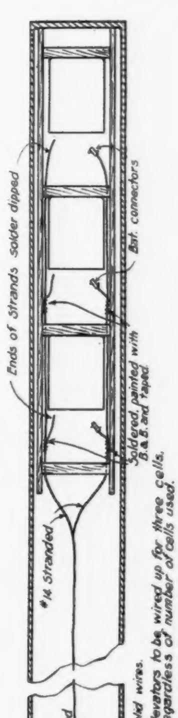


Fig. 271. Wiring of Elevator in Battery Chute. C. M. & St. P.

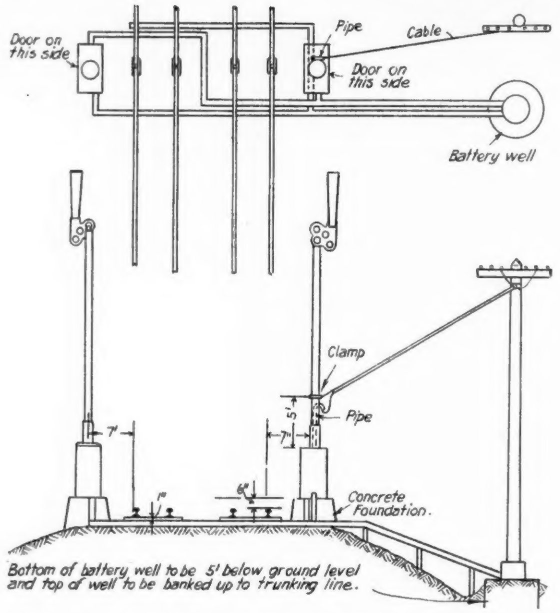


Fig. 274. Layout of Apparatus at Double Signal Location. C. M. & St. P.

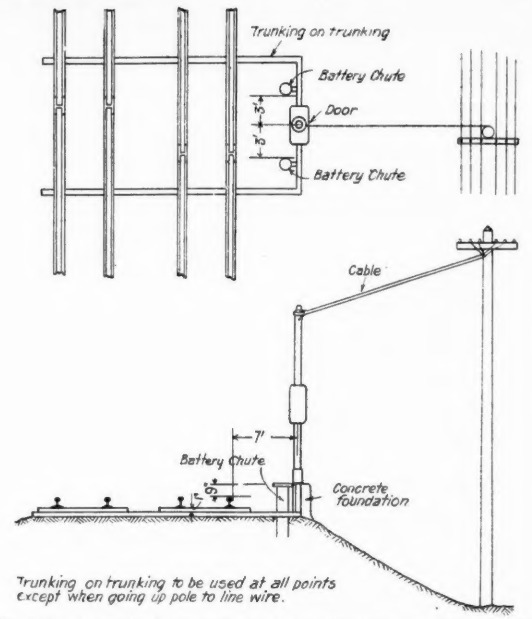


Fig. 275. Layout of Apparatus at Cut Section. C. M. & St. P.

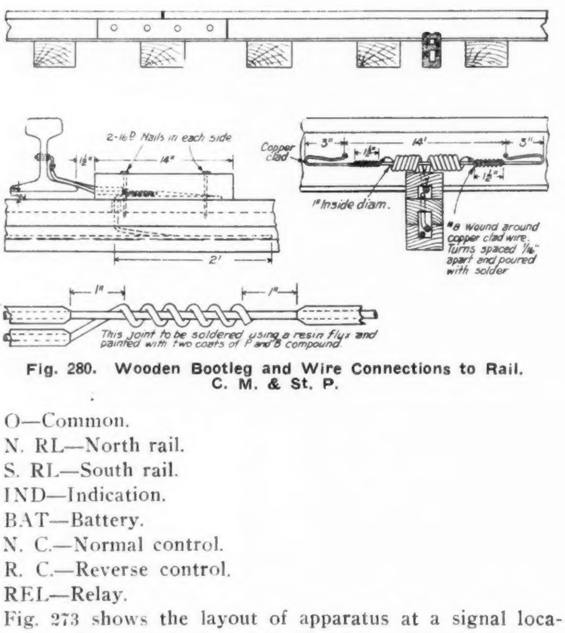


Fig. 280. Wooden Bootleg and Wire Connections to Rail. C. M. & St. P.

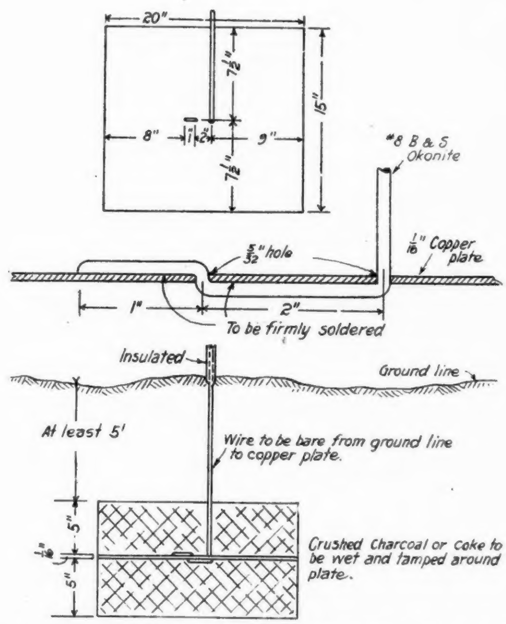


Fig. 279. Ground Plate and Method of Installation. C. M. & St. P.

O—Common.
N. RL—North rail.
S. RL—South rail.
IND—Indication.
BAT—Battery.
N. C.—Normal control.
R. C.—Reverse control.
REL—Relay.

Fig. 273 shows the layout of apparatus at a signal location on single track, Fig. 274, the same with two signals opposite, and Fig. 275, a cut section layout. Fig. 276 shows methods of installing trunking and wires at three different signal locations.

Fig. 277 is a concrete signal foundation and anchor bolt.

Line wire is strung on the same poles as the telegraph circuits. Vitrified clay insulators are used. Fig. 278 shows method of dead ending. Fig. 279 shows ground plate and method of installation.

Wire ducts are of wooden trunking. Bootlegs are made as shown in Fig. 280.

Fig. 281 shows circuits for power operated distant signals with indication locks at a mechanical interlocking plant, Fig. 282 circuits for power operated distant signals and route locking at a mechanical interlocking plant and Fig. 283 circuits for route locking at a mechanical interlocking plant at a single crossing.

Relays meet the R. S. A. specifications. Track relays are of 4 ohms and line relays 500 ohms resistance.

The following sizes and classes of wire are standard: for leads from line and local wiring, No. 12, B. & S. gage, rubber covered copper; for leads from track, No. 8 B. & S. gage rubber covered copper; in chutes, No. 12, B. & S. gage, stranded rubber covered copper; for line, No. 10, B. W. G. hard drawn, weather-proof copper.

The Washington Water Power Co. has just installed on its suburban electric railway between Spokane and Cheney and Medical Lake, Wash., 27 miles of automatic electric block signals with automatic stops. If the stop signal is disregarded, an iron bar, lowered with the semaphore, will break a glass tube on the top of the leading car and apply the brakes. The signals, which

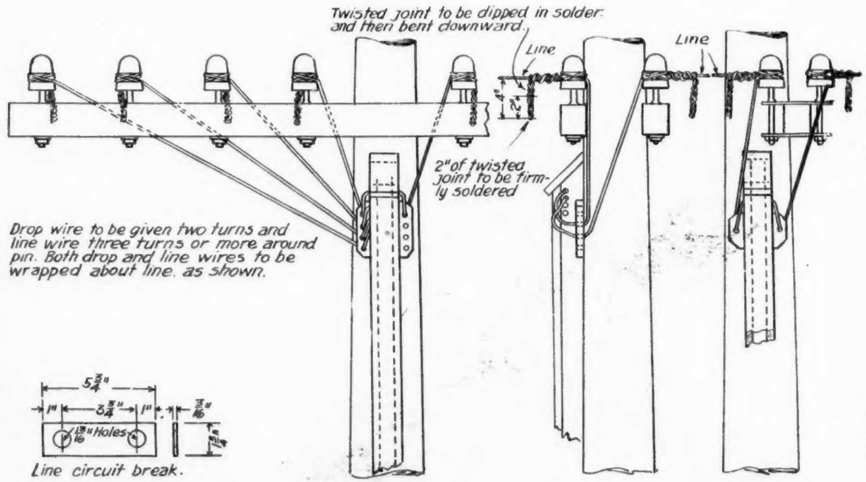


Fig. 278. Pole Line Dead End and Connections to Trunking Lead. C. M. & St. P.

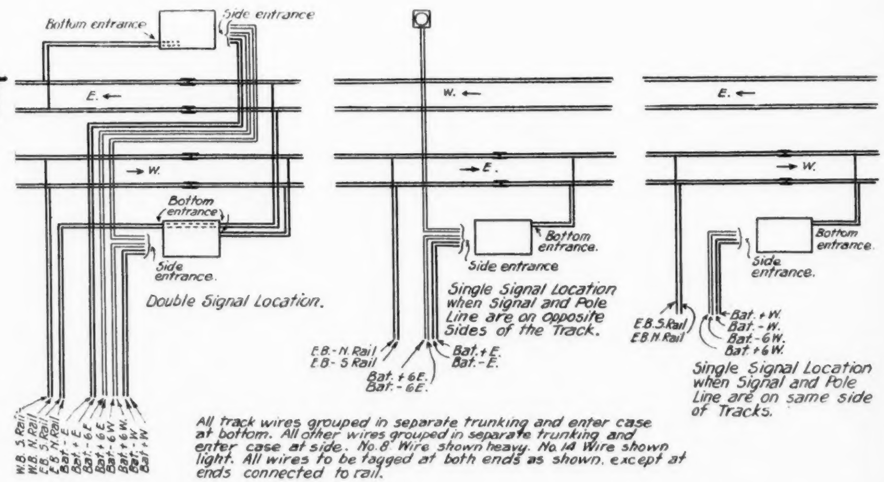


Fig. 276. Layout of Trunking and Wires at Signal Locations. C. M. & St. P.

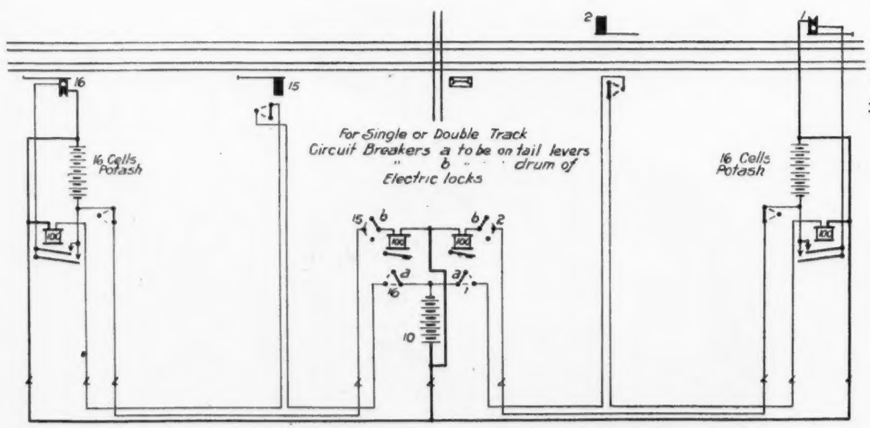


Fig. 281. Circuits for Power Operated Distant Signals at Mechanical Interlocking Plant with Indication Locking. C. M. & St. P.

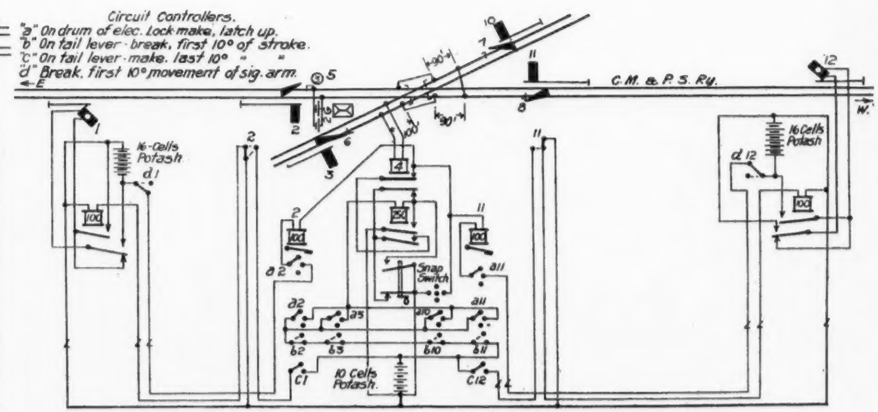


Fig. 282. Circuits for Power Operated Distant Signals, Route and Indication Locking at Simple Crossing. C. M. & St. P.

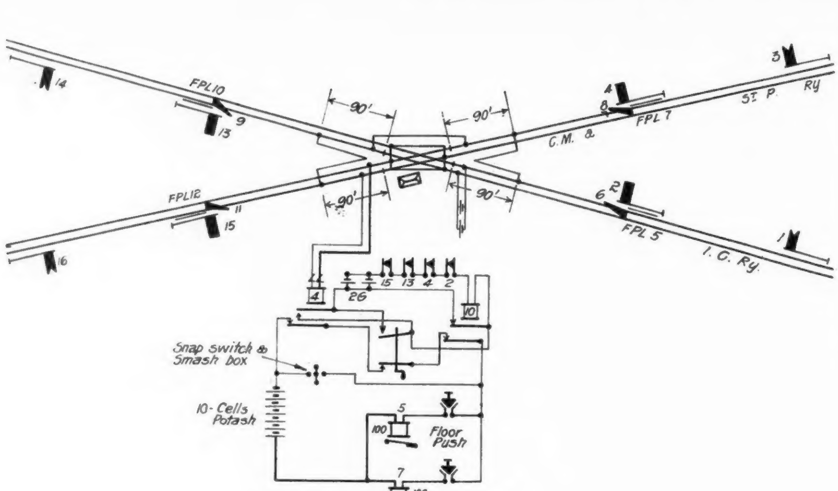


Fig. 283. Circuits for Route Locking at Mechanical Interlocking Plant. C. M. & St. P.

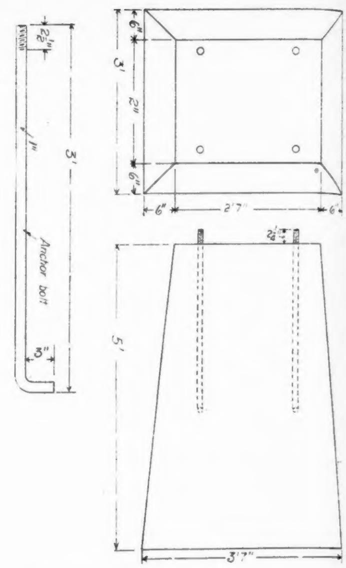


Fig. 277. Concrete Signal Foundation, C. M. & St. P.

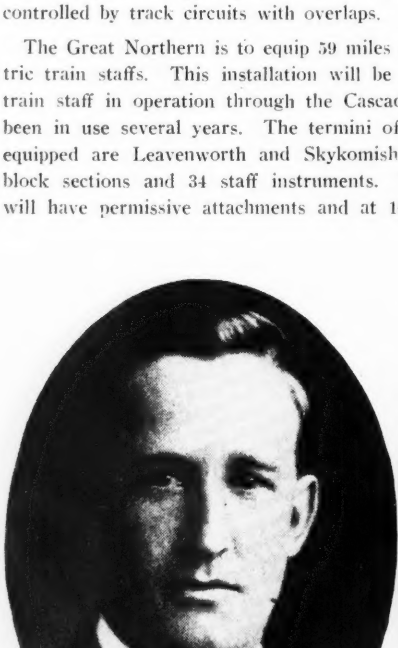
are three-position upper-quadrant with top-post mechanism, are controlled by track circuits with overlaps.

The Great Northern is to equip 59 miles of its line with electric train staffs. This installation will be an extension of the train staff in operation through the Cascade tunnel, which has been in use several years. The termini of the line now to be equipped are Leavenworth and Skykomish. There will be 17 block sections and 34 staff instruments. Thirty-two of these will have permissive attachments and at 16 stations there will be staff cranes, by means of which staffs will be taken up by trains without reducing speed. There will be home and distant signals at every station, by which the operator will have control of the movement of trains into the side tracks.

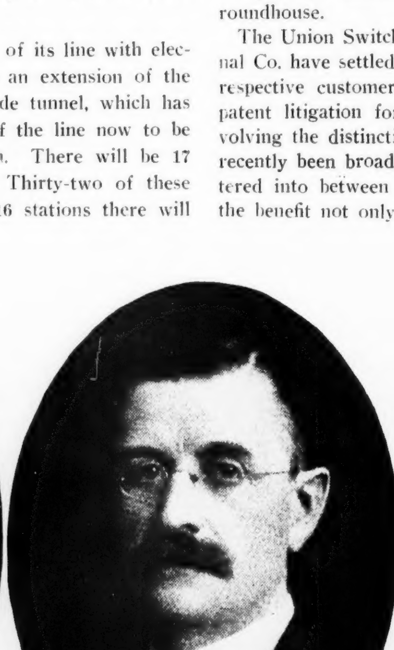
The Pennsylvania has installed an electro pneumatic interlocking plant at Conemaugh, Pa., 35 miles west of Altoona, to take the place of mechanical interlocking. The air pump is in the roundhouse.

The Union Switch & Signal Co. and the General Railway Signal Co. have settled their patent litigation in such way that their respective customers shall be entirely exempt from danger of patent litigation for the automatic block signaling systems involving the distinctive current, on which the Struble patent has recently been broadly sustained in court. By the agreement entered into between these companies, their customers may have the benefit not only of this broad principle in its original form, but in any of the forms represented by the numerous improvement patents up to the present time, including the Young patents.

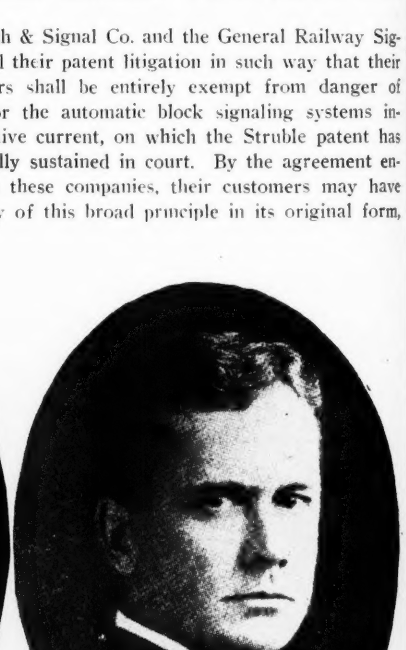
The Grand Trunk Railway of Canada has introduced telephones for train dispatching between North Parkdale junction, Ontario, and Burlington junction, 145 miles, and also on another line in that region, 165 miles long.



C. E. Denney,
Sig. Engr., L. S. & M. S. Pres. R. S. A.



C. C. Rosenberg,
Cons. Sig. Engr. Secy.-Treas. R. S. A.



J. A. Peabody,
Sig. Engr., C. & N.-W.

REPORT OF COMMITTEE NO. VI.—AUTOMATIC STOPS AND CAB SIGNALS.*

History.

The history of the progress of Automatic Stops and Cab Signals up to the summer of 1909 has been very well covered in previous reports of this committee. A great number of schemes and inventions have been brought to the attention of the public, and some of them have characteristics which should be valuable in a system using them. Tests of systems have been made in different parts of the country, some of which have been witnessed by members of your committee. These tests indicate that there are several men working seriously and on proper lines to develop a system of automatic stops or cab signals which will meet the requirements of railroads.

The principal systems which have been brought to the attention of your committee during the past year are as follows:

The Kramlict System: This is a mechanical trip, automatic stop system only. Levers on the ground engage with valves on the rolling stock which admit air from a special reservoir to a cylinder which closes the throttle, and at the same time admits air to another cylinder which applies the brakes. An important feature of this system is the use of duplicate ground levers and valves which must operate simultaneously to actuate the apparatus, thus avoiding unnecessary stopping of trains due to the presence of obstructions on the right of way engaging with the train valve.

The Higgins-Sheridan System: This system is for use with a system of fixed signals using track circuits.

Track coils energized from a power line and located at fixed signal locations form the primaries of transformers, the secondaries of which are coils placed on the rolling stock. Energy for the track coils is controlled by the track relays and circuit controllers on the fixed signals, and energy induced in the coil on the rolling stock when passing over the track coils controls a relay on the rolling stock, which in turn controls the cab signal indications.

The Williams System: This is an intermittent third rail system operated in connection with a system of fixed signals. The position of a fixed signal controls a circuit which transmits energy through the third rail and contact shoes to control the steam and brake equipment of the rolling stock. A test of this system has been made at Ford, Va., on the private line of the Brill Lumber Company.

The Long Distance Locomotive Control Company System: This is a continuous third-rail system. Power is supplied from a power house and furnished in the third rail at 200 or 110 volts, depending on the condition of the track circuits in advance. In this system preliminary information is given that the automatic stop will be applied. A test of this system was made on the Hightstown & Pemberton Railroad at New Egypt, N. J.

The La Croix System: This is a continuous third-rail system, energy for whose operation is provided by a generator on the rolling stock, the circuit being established through the rolling stock, one of the running rails, the third-rail contact shoe and the points of a track relay. An important feature of this system is the generator which is so designed as to be slow acting to prevent unnecessary operation of the apparatus, due to breaks or inequalities in the third rail.

The Fox-Lenderoth System: In this system a section of non-magnetic rail is substituted for the ordinary rail in the track at points where the indication is to be given. A piece of magnetic rail or suitable bar is so arranged that it can be placed along the non-magnetic section. Magnets, energized by power located on the rolling stock, are suspended from the rolling stock in close proximity to the running rail. The indication is given on the rolling stock by the passage of the armature of the magnets over the non-magnetic section of rail.

The Harrington System: This is a mechanical trip type of automatic stop. A weight suspended by a chain from the track engages, when in the lower position, with an arm on top of the rolling stock, which operates a valve controlling the air brake equipment. When the suspended weight is raised the rolling stock will pass under it without being hit. A test of this system has been made on the Erie Railroad.

The Lauder-Patterson System: This is a cab signal system which may be accompanied by automatic stop and speed control features if desired. The apparatus consists of an A. C. generator, and relay in the cab, one-half of a transformer suspended beneath the cab and the other half of the transformer placed on the track. The windings of the track transformer are controlled by track circuits and control the flow of current in the engine transformer, which, with the relay are connected in series to the generator, the maximum current being drawn when out of the field of influence of the track transformer. The indications are given by lights and are controlled through the relay by the condition of the track transformer. There are no contacts of any kind between the engine and track devices, the system operating entirely by induction.

Three of these have come under the personal observation of one or more members of the committee in the form of tests and the others by plans and descriptions which show clearly the principles on which the schemes are being worked out. Tests of some of these systems will shortly be made.

Taking a broad view of the subject it seems that considerable progress has been made during the year and a much greater interest is being shown by railroad officers in automatic train control devices than at any time heretofore.

Reports and descriptions of systems have appeared from time to time in the technical press, and some very interesting and instructive literature on the automatic train control problem is incorporated in the second annual report of the Block Signal and Train Control Board to the Interstate Commerce Commission.

An outline of the conditions and principles involved in the train control problem, as they are seen by Messrs. Fox & Lendreoth, the inventors of one of the systems above referred to, has been brought to the committee's attention and is presented herewith for the information and consideration of the association.

Discussion.

Your executive committee's instructions to this committee were to "bring up to date all literature and actions suggested or ordered at the last annual meeting." The discussion at Louisville a year ago on the report of last year's committee seemed to indicate clearly a dissatisfaction, not only with the requisites of installation proposed by the committee of 1909, but also with those contained in the report of 1908, which were adopted by the association by letter ballot.

There is no question in the minds of the committee that a system of automatic stops or cab signals designed and installed in accordance with the adopted requisites of this association will meet all requirements of actual service on a railroad, but the committee also believes that in the present state of the art, a list of requisites which would allow greater freedom in design and installation would have a tendency to promote progress without letting down the bars to admit undesirable schemes or impair the safety of railroads employing a system designed and installed in accordance therewith. This belief is borne out by the fact that a number of systems of train control devices are now in service or have undergone exhaustive tests which do not comply with several of the

*Railway Signal Association.

adopted requisites, but which give a much greater degree of protection from accidents than it is possible to obtain without them. This does not refer only to systems installed on lines of specialized and uniform traffic but to lines of a general and irregular description such as would be met with on a majority of roads of this country as well.

In following the instructions of the executive committee, your committee has endeavored to harmonize the adopted requisites of installation with the idea of the members of the association as expressed in the discussion of the report of the committee of 1909, and in so doing has modified certain of the adopted requisites and has added some requirements which is deemed proper.

In the discussion of this subject in committee, it seemed that some of the requisites should not be so classed on account of their being not essential to the safety or reliability of the system. It is reasonable to assume that a system could be designed, which, while not having all the refinements and adjuncts which would be desirable in a system, still had all the features which are necessary for the proper protection of traffic. The committee has deemed it proper, therefore, to present a list of desirable characteristics or adjuncts, in addition to the essential characteristics, or requisites.

Furthermore, the difference between the requisites of installation for systems of automatic stops on steam and electric lines seemed so slight that it was decided to combine the two. Your committee, therefore, presents for discussion and consideration the following requisites and other desirable characteristics as being in accordance with the instructions of the executive committee.

It is the opinion of the committee that in the present state of the art, the automatic stop and cab control system should be used only in connection with a system of fixed signals, and the following requisites have been prepared on this basis:

Requisites.

1. Apparatus so constructed that it may be used on either steam or electric roads, and under any physical conditions to be encountered on said roads.

2. Apparatus and circuits so constructed that the removal or failure of any essential part will cause the display of a stop indication and the application of the brakes.

Note: This requisite is intended to apply only within the limits of the strength of material and good designing practice.

3. Apparatus so constructed that it may be used with either the absolute or permissive operation.

With either system the restoration of the stopping device and the release of the brakes must be within the control of the engineman or trainmen, but only after the speed of the train has been reduced to .... miles per hour.

4. Apparatus so constructed that it will be operative under all weather conditions that permit of the operation of trains.

Note: The qualifications contained in the latter part of this requisite was added to the adopted requisites, as it seemed manifestly unfair to require the train control devices to operate when no trains could be operated.

5. Apparatus so constructed that it will conform to the standard clearance on the road on which it is to be used. The roadway parts should not extend within the lines of maximum equipment of rolling stock, and the engine or train parts should not extend outside the lines of minimum clearance for structures, but at the same time, the proper operative relations should be obtainable under all conditions of speed, weather, wear of rolling stock, or train oscillation or shock.

6. Apparatus so constructed that two or more engines may be used with one train or a train may be allowed to assist another train without causing the brakes to be set on the second or following engine when passing a signal which indicated proceed when the head of the train passed it.

7. Apparatus constructed as to be capable of control by the means used for indicating the condition of the block about to be entered, such as an electric track circuit.

8. The automatic stopping device should be operative only in the normal direction of traffic, except in connection with signals governing reverse movements.

9. The cab signal shall be a visible signal of prescribed form, the indication being given continuously by not more than three positions of color.

10. The cab signal should indicate the condition of the block about to be entered.

11. An audible signal should be provided in addition to the visual signal, and where "stop" and "proceed with caution" indications are given, separate and distinct audible signals shall also be provided.

Desirable Characteristics.

1. Apparatus so constructed that "speed control" may be used if desired, that is, if the speed of the train has been reduced to a pre-determined rate, should, without being stopped, be allowed to pass a stop which would apply the brakes if the train were moving at greater than the said pre-determined rate of speed.

2. Apparatus so constructed that the release of the brakes by the engine or train crews can be accomplished only after the train has been brought to a stop; or if the speed control is used, when the speed of the train has been reduced to the pre-determined speed in effect, or when the cause of stopping has been removed.

3. Apparatus so constructed that an audible alarm shall be given in the cab each time the stopping device has supplied the brakes.

4. Apparatus so constructed that the cab signal shall give an indication of the condition of the next block in advance of the block about to be entered.

5. Apparatus so constructed that the cab signal shall be correctly displayed when the engine is moving either forward or backward.

6. Proper apparatus should be provided on the engine to record the number of times the automatic stopping devices have applied the brakes.

THE ELECTRIC BOLT LOCK AS APPLIED TO ALL TYPES OF INTERLOCKING.*

The mechanism of a mechanically interlocked switch consists of a means of throwing the switch, a means of locking it in both positions, and a means of indicating its position. The weakest point is the bolt lock; it is cumbersome and expensive to apply to any but a few switches in a route. Without bolt lock we must depend upon the facing point lock altogether, with the result that our trust may be betrayed in a number of ways. Pins can work out and do, despite cotter keys and other checks. The cranks and compensators also can work loose from their foundations or the foundations move. Any one of these causes can so bring it about that a switch will not respond to its lever, thus allowing the lock plunger to re-enter the hole in the lock rod from which it was withdrawn, or the switch may not complete its stroke and a break in the facing point lock connections, or a loose part allow the lock lever to be thrown. In any event the signalman has no intimation that anything is wrong. The lock rod or plunger or any other part of the mechanism can be removed, as in making repairs, and the working of the levers is not affected. In other words, nearly any failure through breakage, removal of a part, or by reason of lost motion is what is known in block signal practice as a **clear failure;** it is not on the side of safety.

Now it is possible and feasible to provide a reliable check

*From the report of sub-committee A., committee No. 3, Railway Signal Association.

on the working of a mechanically interlocked switch. In one system of electric interlocking, a device is used which so brings it about that a switch must be fully thrown and locked before an indication is received at the lever. If the plunger re-enters the hole from which it was withdrawn, i. e., if the lock rod does not move, no indication will be received at the lever. If any part is removed, as the lock rod or plunger, no indication will be received at the lever. This is accomplished by making the stroke of the indication controlling contacts dependent upon the movement of the lock rod itself through its full stroke and of the movement of the plunger through the hole in the lock rod; the end of the plunger after having passed through the hole, completes the stroke of the controller. **To make protection complete, one thing is necessary, to make governing signal, when clear, lock the switch and to make the switch, when unlocked, place and hold the signal in the stop position.** In other words, the presence or absence of any part of the switch locking apparatus, as well as its proper movement together with that of the points should be detected, and in addition, a device should be provided to hold such apparatus in its final position.

These safeguards may properly be called an electric bolt lock and they can be easily applied to a mechanically interlocked switch. One method of application would be as follows:

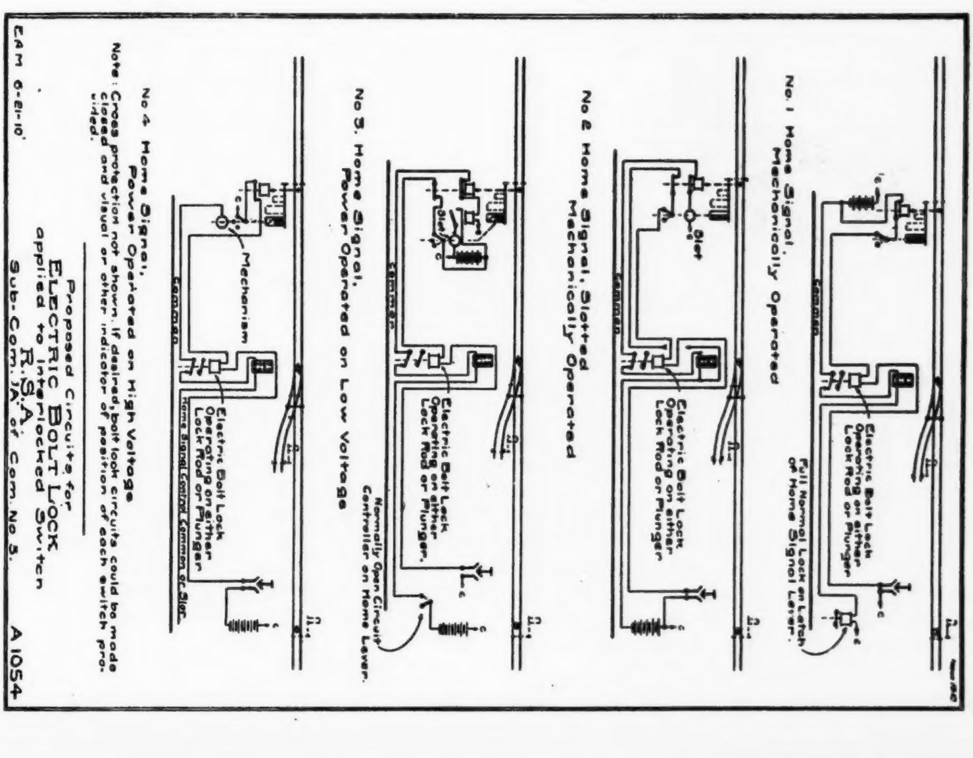
Provide an electric lock on the signal lever to lock the latch down with the lever normal and the lock de-energized. The circuit for the lock would pass through two controllers, one actuated by the locking plunger and one by the lock rod itself.

The controller actuated by the plunger should be carried on the dog of an electric lock situated at the switch and so arranged that when de-energized the dog will drop into a notch in the end of the locking plunger, when the plunger is in locking position, and close the circuit when in this position only; when raised out of the notch or when dropped below it, due to the absence of the plunger, the circuit should be open. The circuit for this lock should be through a normally closed controller on the signal arm, normally closed controller on the signal lever latch, and controller on the latch of the switch lever, so arranged as to be closed only with the latch up, but to be open with the latch down and the lever in either position. With this arrangement the operation would be as follows:

In lifting the latch of the switch lever the circuit for the electric lock on the plunger would be energized, raising the dog from the notch and releasing the plunger. This would open the circuit on the signal lever lock at this point, it being already open at the controller on the lock rod. The switch could now be thrown closing the circuit of the signal lever lock through the controller on the lock rod; at the end of the stroke the latch being lowered would open the circuit of the plunger lock, allow the dog to drop into the notch, close the circuit of the signal lever lock through the contacts on the dog, and release the signal lever. Clearing of the signal would open the circuit of the plunger lock both at the lever and blade, thereby holding the plunger in place. Any failure of any part of the apparatus would prevent the movement of one of the levers concerned, thereby instantly calling attention to the fact that something was wrong. Absence of the plunger or lock rod would have the same effect. In the case of power operated or slotted signals the lock on the signal lever might be omitted and the signal control circuit taken through the controllers as described for the lock circuit. The reason for making the lock at the switch act on the plunger rather than on the lock rod or some other part is that there is no strain on the plunger, consequently the dog would not be likely to jam; also it is desirable to detect the presence or absence of the plunger. Cross protection could be afforded by shunting the lock circuit to common whenever the former is broken.

One great advantage of the above described apparatus would lie in its adaptability to electric detector locking. All the locks on switches in a single route or section of route could be combined on one circuit and be actuated by the latch on a route or key lever, or by a floor push, thus minimizing the amount of electrical apparatus needed in tower, and the combined control circuit could be taken through the point of a track relay. Thus the presence of a train in the section would lock the plungers of the switches themselves, which is the theoretically correct method.

There is the matter of cost yet to be considered. It would, no doubt, be exceedingly expensive to equip all signal levers with



electric locks, but by suitable mechanical locking, a key lever could be provided which would have to be reversed before any signal could be cleared and a lock attached to such lever. In that case more protection would be afforded than is now had when dwarf and low speed signals are rarely bolt locked. As a matter of fact, even high speed signals are often bolt locked only with such facing points as occur between the signal and the tower, and when power signals are used there is no equivalent of the bolt lock at all (a switch box merely controls the signal, it does not lock the switch). As with this system a switch could be operated and locked by one pipe line if desired, in many cases there would be an actual saving in that by doing away with the separate facing point lock, there would be fewer levers with their attendant connections between the tower and switches. Thus there would be economy of levers, pipe line and tower room. The saving probably would be comparatively small however, as it is safe to say that the cost of the electrical apparatus would equal that of the mechanical material displaced. Perhaps there would be a saving of money in the size of tower needed in large plants. However, in view of the added safety and reliability secured, even an additional expenditure would seem warranted.

There is still another factor to consider, viz., operation. By concentration, fewer levers are needed for any given route, consequently fewer movements are required to set up a route. This would result in economy of time which is frequently an important matter.

By adopting some such arrangement of apparatus as above suggested the following results would be gained at probably no additional cost over present practice. (a) Failure would be on the side of safety. (b) Mutual locking between all switches and signals in a route would be secured. (c) Failure would be promptly detected. (d) Electric detector locking could be applied at the vital point, i. e., the locking plunger of the switch. (e) Fewer levers and their connections might be required, resulting in (f) Economy of time in setting up routes, thus facilitating train movements.

We consider that it is equally advisable to apply a similar device to power interlocked switches and we firmly believe that in all cases the apparatus should operate on plunger and lock rather than on any other piece of control apparatus. We believe that the plunger and the lock rod are the vital points and if they are held secure, and their presence or absence detected, a switch will be as safe as it is possible to make it.

We submit herewith several circuit plans showing, in outline only, suggested methods of control in slightly varying situations of the bolt lock. It is believed that detailed description of each of these circuits is unnecessary, No. 1 having been fairly well described in the above detailed report.

Personals

W. F. Cook, Insp. Sigs., D. & H.

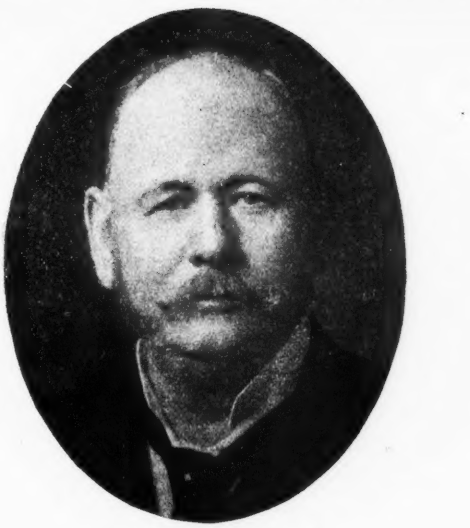
E. M. Cartes, Supv. B. & B., Tenn. Cent.

W. F. Cook entered service of the Pennsylvania on the New York division in 1896 on construction of automatic block signals. He resigned in 1900 and took a position with the Pneumatic Signal Co., which at that time was installing a low pressure pneumatic plant on the New York Central at 42nd street, New York. In 1903 he entered the service of the Delaware & Hudson at Albany as repairman of a low pressure pneumatic plant, and in 1906 was appointed inspector of interlocking, which position he now holds at Green Island, N. Y.

Alfred Craven, deputy engineer of the New York Public Service Commission, First district, at New York, has been appointed engineer in charge of subway construction, succeeding George S. Rice, resigned.

E. M. Cartes commenced work as an apprentice on the Wabash in the bridge and building department and also as rodman for the engineering department. After four years service he was promoted to foreman of a gang and later to bridge inspector of the Illinois lines. Leaving the Wabash he went to the Edge Moore Bridge Co. in the erecting department, and in 1892 to the Illinois Central, taking charge of a gang in connection with elevation work for the World's Fair and served in the capacity of supervisor of bridges and buildings for five years, also having charge of one of the steel erecting gangs. Leaving the I. C. in 1903 he went to the Tennessee Central as supervisor of bridges and buildings, which position he has held for the past seven years.

W. S. Boyce has been appointed a roadmaster on the Middle division of the Santa Fe, with office at Newton, Kan.



J. T. Harahan, Pres. I. C.

J. T. Harahan, president of the Illinois Central, has declared his intention to retire under the pension system of the road on or before January 12, 1911. Mr. Harahan was born at Lowell, Mass., on January 12, 1841, and, therefore on January 12, 1911, he will have reached the maximum of 70 years, at which retirement is provided for by the pension regulations of the Illinois Central. It is understood that the place of chairman of the board will be created and that Mr. Harahan will be appointed to it.

F. S. Stevens, superintendent of the Philadelphia & Reading and subsidiary companies, at Reading, Pa., has been appointed engineer maintenance of way, succeeding C. H. Ewing, transferred.

The jurisdiction of J. M. Reid, chief engineer of the National Railways of Mexico at Mexico City, Mex., having been extended over the Pan-American Railroad and the Veracruz & Isthums, D. D. Colvin, chief engineer of the Pan-American Railroad at Gamboa, Oaxaca, Mex., has been appointed assistant chief engineer of that company and the Veracruz & Isthmus, with office at Terra Blanca.

Marvin Hughitt, president of the Chicago & North Western, has retired to become chairman of the board of directors. W. A. Gardner, vice-president in charge of maintenance and operation, has been elected president, succeeding Mr. Hughitt. Samuel A. Lynde, general attorney at Chicago, has been elected vice-president in charge of legal and financial departments, succeeding E. E. Osborn, retired on account of ill health.

Warren G. Purdy, former president of the Chicago, Rock Island & Pacific, and for thirty-five years prior to 1901 an official of that road, died at his residence in Chicago, Oct. 13, at the age of 67 years. He was president of the Chicago, Rock Island & Pacific from June 1, 1898, to December, 1901, when, owing to failing health, he resigned. Mr. Purdy was born in Baltimore in 1843 and began his railway service in 1859 at the age of 16 as a clerk in the office of the Illinois Central. For two years he was chief clerk in the quartermaster's department of the United States army, and in 1867 became a bookkeeper in the cashier's office of the Chicago, Rock Island & Pacific at Chicago. He was promoted to cashier, secretary and treasurer in turn, and in 1887 was elected second vice-president. In 1897 he was made first vice-president, and in 1898, president of the road.

J. Beaumont has been appointed signal engineer of the Chicago Great Western at Chicago, vice W. H. Fenley, resigned to engage in other business.

W. I. Elliott, roadmaster on the Twenty-first track division of the St. Louis & San Francisco at Pittsburg, Kan., has been transferred to the Fourteenth track division, with office at Fort Scott, Kan., succeeding J. Coughlin, resigned. D. C. Davis, road-roadmaster on the Twenty-second track division at Pittsburg, succeeds Mr. Davis, and S. B. Peters succeeds Mr. Elliott.

George H. Webb, chief engineer of the Michigan Central, has been appointed also chief engineer of the Detroit & Charlevoix, with office at Detroit, Mich.

E. L. Burdick has been appointed assistant engineer of tests of the Atchison, Topeka & Santa Fe, with office at Topeka, Kan.

Ralph Budd has been appointed chief engineer of the Spokane, Portland & Seattle, with office at Portland, Ore., succeeding T. H. Croswell, resigned.

J. Coughlin, roadmaster of the St. Louis & San Francisco at Ft. Scott, Kan., has been appointed roadmaster of the Kansas City Southern, with office at Neosha, Mo.

Richard H. Aishton, general manager of the Chicago & North Western at Chicago, has been elected vice-president in charge of maintenance and operation, with office at Chicago, succeeding W. A. Gardner. Mr. Aishton was born at Evanston, Ill., in June, 1860. He was educated in the public schools at Evanston and began railway work in 1878 as an axman with an engineering corps on the Chicago & North Western. He remained in the engineering department until 1895, being promoted consecutively to rodman, division engineer, roadmaster and superintendent of bridges and buildings. He was then transferred to the operating department, first as trainmaster, and was later promoted to assistant superintendent, superintendent and general superintendent. He was appointed assistant general manager in 1902, and four years later was made general manager. Mr. Aishton is chairman of the General Managers' Association of Chicago.

F. B. Sheldon, assistant to the president and chief engineer of the Hocking Valley at Columbus, Ohio, has been elected president of the Kanawha & Michigan, with office at Columbus, succeeding Nicholas Monsarrat, deceased.

With the Manufacturers

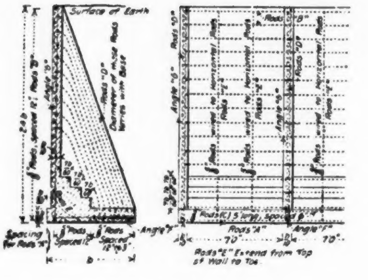
George W. Jackson, Inc., of New York and Chicago, has just issued two pamphlets descriptive of the bridge and structural steel and subway departments. These pamphlets consist of maps, half-tone illustrations, and brief descriptions of various undertakings, such as the Blue Island avenue Canal tunnel, Chicago, the Illinois Tunnel Co.'s system, bascule bridges and other steel structures for which the material was furnished or which were built by the company. There are also drawings and specifications of patents for methods and devices owned by the company. These pamphlets represent a high appreciation of the artistic in advertising and are well worth careful study.

A Simple and Efficient Retaining Wall.

The retaining wall shown in the accompanying cut, while it has several features in common with other unpatented designs has some features that distinguish it from the others. These features are improvements that greatly increase the efficiency of the concrete and the steel reinforcement and the safety of the wall.

The wall here shown is a design upon which Mr. Edward Bodfrey, of Pittsburg, Pa., has been granted letters patent. The patent covers particularly the anchors in the curtain wall and the slab to which the rods in the rib are attached, also the concrete shown in steps in the cut.

A solid masonry wall, in order to have stability enough to resist the earth pressure may, and often does exert such pressure, especially on the front edge of its foundation, as to cause settlement and bad alignment or failure. The L-shaped wall has very much less mass than the solid one, and therefore the



soil pressure is less. The ribs, with their tie rods, enable the slab and curtain wall each to act as simple beams and not as cantilevers, as in some L-shaped designs, thus simplifying the stresses and the reinforcement.

Anchorage of the tie rods in the two slabs which they hold together is absolutely essential in a proper design. This is lacking in many designs but supplied here. Failure of this wall would require complete tearing apart of inter-dependent and positively connected steel rods.

This system of design was used in a wall 64 feet high at Melwood avenue, Pittsburg in 1907. It was used in very extensive flood protection work in Grand Rapids, Mich., in 1908. It is an economic and efficient retaining wall and is so designed that all reinforcing steel is held in its proper place with minimum of care and trouble.

The Signal Appliance Association at its annual meeting, held in Richmond, Va., in connection with the Railway Signal Association convention, elected for the ensuing year the following officers: A. F. Klink, Bryant Zinc Co., chairman; H. M. Buck, Railway Supply Co., vice-chairman; Frank Edmunds, Dressel Railway Lamp Works, secretary; H. M. Sperry, General Railway Signal Co., treasurer. The executive committee consists of the officers and Avery P. Eckert, National India Rubber Co., Azel Ames, Kerite Insulated Wire & Cable Co., Fred A. Poor, Rail Joint Co., and J. S. Hobson, Union Switch & Signal Co.

Exhibitors at the Convention of the Railway Signal Association.

Adams & Westlake Co., Chicago. Showing switch, signal and train lamps. Represented by W. H. Baldwin, Assistant General Manager, Chicago; A. S. Anderson, Chicago; C. B. Carson, Chicago; W. J. Pierson, Chicago; H. G. Turney, Chicago; E. L. Langworthy, Eastern Manager, Philadelphia, and F. N. Grigg, Philadelphia.

American Railway Signal Co., Cleveland, Ohio. Represented by G. L. Weiss and H. M. Abernethy.

American Vulcanized Fibre Co., Wilmington, Del. Showing fiber joint plates, fiber end posts, fiber bushings.

Armspear Manufacturing Co., New York. Showing steel lamps and longtime burners. Represented by C. K. Freeman.

Banks Electric & Manufacturing Co., New York. Showing the Banks primary cell. Represented by W. C. Banks and George W. Daves.

L. S. Brach Supply Co., New York. Showing the Brach type 20 lighting arrester, the new type 23 lighting arrester, lightning arrester cabinets, the Victolac trunking paints, the new Universal die stock and other specialties. Represented by L. S. Brach, H. E. Gifford, and A. G. McClure.

Bryant Zinc Co., Chicago. Showing interlocking relays, crossing bells, indicators, lighting arresters and the Premier electrical instruments. Represented by E. M. Deems.

Buda Manufacturing Co., Chicago. Showing Buda motor cars. Represented by J. L. Artmaier and R. M. Smith.

Central Electric Co., Chicago. Represented by J. M. Lorenz and Charles E. Brown.

Corning Glass Works, Corning, N. Y. Represented by Dr. Wm. Churchill and Fred Cameron.

Commercial Acetylene Co., New York. Represented by R. E. Bruckner and R. P. Steward.

Dixon Crucible Co., Joseph, Jersey City, N. J. Showing paint and pipe joint compound. Represented by Henry W. Chase.

Dielectric Co. of America, Belleville, N. J. Represented by R. T. Hungerford.

Dressed Railway Lamp Works, New York. Showing signal, switch and semaphore lamps, long-time and one-day burners, oil founts and engine and tail marker lamps. Represented by Robert Black, F. W. Edmunds and B. Palmer Clairborne.

Duntley Manufacturing Co., Chicago. Showing the Rockford motor car. Represented by G. E. Graber.

Duplex Metals Co., New York. Showing Copper-Clad line wire, tie wire and Copper-Clad nails. Represented by J. F. Kinder, W. T. Kyle and George P. Fondersmith.

Edison Manufacturing Co., Orange, N. J. Showing the Edison primary cell and a number of novel features in battery construction. Represented by E. E. Hudson, E. W. Brown and F. J. Lepreau.

Edison Storage Battery Co., Orange, N. J. Showing the new Edison storage battery for interlocking and portable use. Represented by H. G. Thompson.

Electric Storage Battery Co., Philadelphia, Pa. Showing the Chloride accumulator, the Exide and Tudor cells and the Permanized negative plante plates and the Permanized Westinghouse negative. Represented by G. H. Atkin, H. H. Beck, H. E. Hunt and Hugh Lesley.

Fairbanks, Morse & Co., Chicago. Showing the new type No. 28 two-cycle gasolene engine motor car, the type 2-J motor car and a new bonding drill. Represented by A. A. Taylor, J. L. Jones, W. W. Adams and C. T. Fugitt.

Federal Signal Co., Alabany, N. Y. Represented by John T. Cade, Harry Cade and Aaron Dean.

Galena Signal Oil Co., Franklin, Pa. Showing signal and headlight oils. Represented by John W. Bunn.

General Electric Co., Schenectady, N. Y. Showing A. C. and D. C. relays, tower indicators, mercury time release, resistance units, panel boards and testing instruments. Represented by Frank Rhea, F. B. Corey, H. K. Ferguson and C. H. Jones.

Gould Storage Battery Co., New York. Showing signal batteries. Represented by George R. Berger.

General Railway Signal Co., Rochester, N. Y. Represented by H. M. Sperry, Morris Wuerpel, F. O. Poor, F. L. Dodgson, L. Thomas, Mark Briney, W. P. Graves and M. F. Geer.

Graselli Chemical Co., Cleveland, Ohio.

Gray & Sons, Peter, Boston, Mass. Showing switch signal, bridge and tail marker lamps, burners, including new automatic electric burners and acetylene gas burners and founts. Represented by George M. Gray, J. M. Brown and J. F. Leonard.

Hall Signal Co., New York. Represented by W. H. Lane, Harry L. Hollister, G. W. Hovey, W. A. Peddle and H. J. Mullineaux.

Hazard Mfg. Co., Wilkes-Barre, Pa. Represented by R. A. Peet.

Kerite Insulated Wire & Cable Co., New York. Represented by R. D. Brixey, Azel Ames, P. W. Miller, G. V. Watson, R. A. Patterson and J. A. Renton.

Lawrence Electric Co., F. D., Cincinnati, Ohio. Represented by Charles F. Nolloth.

Lutz-Lockwood Co., Aldene, Union County, N. J. Represented by W. M. Kinch and George Marloff.

Lauder & Patterson, New York. Represented by H. K. Patterson.

Macbeth-Evans Glass Co., Pittsburg, Pa. Showing lenses for switch and signal lamps. Represented by J. M. Barnett.

Massey Co., C. F., Chicago. Represented by C. F. Massey.

Metallic Tie Co., Salt Lake Cty. Showing Universal metallic tie.

National Carbon Co., Cleveland, Ohio. Showing the Columbia dry cell, the new multiple battery, the Columbia track battery and battery specialties. Represented by M. H. Moffett and E. L. Marshall.

National India Rubber Co., New York. Represented by Avery P. Eckert.

Okonite Co., New York. Represented by John Langan.

Pocket List of Railroad Officials, New York. Represented by J. Alexander Brown.

Rail Joint Co., New York. Represented by Fred A. Poor, V. C. Armstrong, R. W. Smith and E. F. Schermerhorn.

Railroad Supply Co., Chicago. Showing locomotive and standard types of crossing bell, battery supplies, channel pins, bonding tools, fiber and aluminum tags, new model 2 switch box hand-controlled circuit breakers. Represented by E. W. Vogel, H. M. Buck and J. F. Leonard.

Railway Specialty and Supply Co., Chicago. Showing the Arc-damp, lighting arrester, the P. M. rail anchor and bond wire protectors. Represented by Phillip Moore and L. W. Kent.

Roller-Smith Co., Bethlehem, Pa. Showing electrical measuring instruments. Represented by H. I. Shire and W. J. Shire.

School of Railway Signaling, Utica, N. Y. Showing the instruction pamphlets and books of the school. Represented by Fred Lavarack and H. C. Williams.

The Signal Engineer, Chicago. Represented by E. A. Simmons, B. B. Adams, A. D. Cloud, L. B. Mackenzie, Fred W. Bender, C. R. Mills and W. D. Horton.

Simplex Electrical Co., Boston. Showing signal wires and cables.

Standard Underground Cable Co., Pittsburg, Pa. Showing Colonial copper-clad wire. Represented by H. P. Kimball.

Union Switch and Signal Co., Swissvale, Pa. Represented by J. G. Schruder, J. S. Hobson, S. G. Johnson, George Blackmore, W. M. Vandersluis, T. H. Patenall, M. D. Hanlon, L. F. Howard, H. C. McCready, W. H. Cadwallader, W. H. Fenley, J. P. Coleman and C. Coleman.

United States Light & Heating Co., New York. Represented by W. P. Hawley and W. F. Bauer.

Waterbury Battery Co., Waterbury, Conn. Showing new types of Schoenmehl primary cells. Represented by C. B. Schoenmehl and C. L. Schoenmehl.

Watson Insulated Wire Co., Chicago. Represented by J. V. Watson and R. A. Patterson.

Western Electric Co., Chicago. Represented by Geo. H. Porter.

Whall & Co., C. H., Boston, Mass. Represented by C. H. Whall.

Yale & Towne Manufacturing Co., New York. Showing signal locks and padlocks. Represented by C. H. Van Winkle.

Frank B. Harriman, former general manager of the Illinois Central; John M. Taylor, former general storekeeper, and Charles L. Ewing, former general superintendent of northern lines at Chicago, have been bound over to the grand jury by Municipal Judge Mancha Bruggemeyer, of Chicago, on the charge of being parties to a conspiracy to obtain money by false pretenses. Their bail was placed at $10,000 each. The bonds for each one of the defendants were furnished by Henry B. Smith, an insurance agent.

NOTES.

We are indebted to Mr. G. A. Graber, Manager, Ry. Dept., Duntly Mfg. Co., for the picture of the Railway Signal Association Group which appears elsewhere in this issue.

M. V. Hynes, engineer maintenance of way of the Cincinnati, Hamilton & Dayton at Cincinnati, Ohio, has been appointed division engineer of the Toledo division, with office at Dayton, Ohio, his former position having been abolished. I. F. White, division engineer at Dayton, has been transferred to the Indianapolis-Springfield division, with office at Indianapolis.

Hugh McGehee Taylor, who was appointed director of construction of the National Railways of Mexico, in June, with office at Mexico City, Mex., has had his authority extended over the Pan-American Railroad. Mr. Taylor was born March 5, 1870, at Montgomery, Ala. He was educated in the public schools of Montgomery and graduated from the Alabama Polytechnic Institute in 1889 with the degree of B. E. He began railway work in May, 1889, as a draftsman on the Louisville & Nashville and was later masonry inspector and resident engineer on the Alabama Mineral and Birmingham Mineral divisions of the same road. In September, 1891, he went to the National Railroad of Mexico, now a part of the National Railways of Mexico, as supervisor of track, and from October, 1893, to January, 1895, he was consecutively station master, yard master, brakeman and conductor on the same road. He was promoted to trainmaster in January, 1895, with office at Laredo, Tex., and in January, 1900, he was appointed superintendent of the San Luis division. From February, 1902, to March, 1904, he was superintendent of construction for all the lines of the National Railroad of Mexico, and from March, 1904, to June, 1907, he was general manager of the Interoceanic Railway of Mexico, now a part of the National Railways of Mexico. He was appointed assistant general manager of the National Railways of Mexico in June, 1907, and in June, 1910, was appointed director of construction of the same company.

M. O'Laughlin has been appointed a roadmaster of the Rock Island, with office at Little Rock, Ark., succeeding Pat Daily, resigned. He will have charge of the territory from Haskell, Ark., to Eldorado (sub-division 53), and from Tinsman to Crosset (sub-division 53A).

William D. Cantillon, assistant general manager of the Chicago & North Western at Chicago, has been appointed general manager, with office at Chicago, succeeding Richard H. Aishton, elected vice-president, and W. E. Morse, general superintendent at Chicago, succeeds Mr. Cantillon. Samuel G. Strickland, assistant general superintendent at Chicago, has been appointed general superintendent of the lines east of the Missouri river, excepting the Minnesota and South Dakota divisions, with office at Chicago; and Chester T. Dike, engineer and superintendent of construction at Pierre, S. Dak., has been appointed general superintendent of the Minnesota and South Dakota divisions.

The Canadian Pacific will apply to the parliament of Canada at its next session for an extension of time to build the following lines: Lanigan, Sask., to Prince Albert; Wilkie, northerly and westerly towards the Battle river, thence southerly to a connection with the La Combe branch of the Calgary & Edmonton; from Outlook to a junction with the La Combe branch of the Calgary & Edmonton; from Estevan, northwesterly to Forward, on the Weyburn branch; from a point in Townships 6, 7, 8 and 9, 9, Range 30, W., westerly to Lethbridge, Alb.; from a point north of Teulon, Man., to a point between Marsh Point and the north boundary of Township 25, Man.

Trains are now operating over the new cut-off of the Atchison, Topeka & Santa Fe from Fullerton, Cal., east via Placentia to Richfield.

The Rock Island recently sent what it called a "Better Hog Train" through Iowa. It was at once nicknamed the "Breakfast Bacon Special," which seems to be a popular designation. The special aroused so much interest among hog raisers in Iowa that it is now to be sent through Missouri, Kansas, Nebraska and Minnesota. The train consists of seven cars, and on its trip through Iowa carried lecturers from the Iowa Agricultural College, who in less than two weeks, it is said, addressed over 20,000 people on hog culture and the use of hog products. Banks, business houses and schools were closed during the visits of the train, and the results promise even greater returns than those from the "Better Seed Wheat Special" recently run by the same road through Okalhoma.

Passenger trains began running regularly through the Michigan Central tunnel under the Detroit river October 16.

In view of recent serious accidents, in France, it has been charged that the passenger cars are too light. The management of the State Railways replies that there are three kinds of passenger cars. Those marked with two stars are the modern ones, and may be run at the greatest practicable speeds; those marked with one star may not go more than 62 miles an hour, and those without any mark are limited to 56 miles an hour. All kinds of cars may be made up into one train; but in that case written notice must be given to the engineman not to run more than 56 miles an hour. There was one unmarked car in the train recently wrecked, and the engineman had been notified. Whether he ran more than 56 miles an hour cannot be proved; for the engineman was killed, and the speed recording apparatus was demolished.

The first passenger train over the new bridge across the Rio Grande at Brownsville, Tex., was run on October 20. The train bore a party of officers of the Kansas City, Mexico & Orient, who, with a large number of visitors from the East and from Europe, were bound for the City of Mexico.

The Pennsylvania will shortly have available for use on its lines east and west of Pittsburgh and Erie 1,988 solid steel passenger train cars. This includes some 600 Pullman parlor and sleeping cars, as well as a large number of suburban coaches such as the company's shops are just beginning to turn out.

The Chicago, Rock Island & Pacific now has automatic block signals in service, recently installed, between Linn Junction and Vinton, on the Minnesota division, 19 miles, single track, and between Eldon and Clio, on the Missouri division, 78 miles, single track.

Judge Lacombe, in the federal court at New York city, has denied the application of the Kinsman Block System Company for an injunction to forbid the Pennsylvania Tunnel and Terminal Company to use a certain patented apparatus for announcing the arrival of trains at stations.

The Long Island has made a number of installations of General Railway Signal Co. all-electric interlocking plants. The signals are operated by alternating current motors, taking current that is stepped down from the high-voltage transmission line. The machines in the towers are equipped with special ground detectors, which automatically open the circuit in case of short circuits out on the road or interference from heavy foreign currents, thereby preventing the danger of false indications. Upper quadrant signals are used, and have been adopted for all new work.

Track is now being laid on a section of nine miles of the completed roadbed of the Phoenix & Eastern from Winkelman, Ariz., northeast to Christmas. This forms the first link of the proposed connecting line between Winkelman, on the Phoenix & Eastern, and San Carlos, on the Gila Valley, Globe & Northern. Work will soon be started on a line, it is said, from Marshfield, Ore., south to Eureka, Cal.

Second-track work has been authorized on 12.4 miles between Oakdale, Tenn., and Lancing, on the Cincinnati, New Orleans & Texas Pacific. This will complete the double-track from Harriman Junction north to Lancing, with the exception of a section of 1.6 miles, on which there are three tunnels and a bridge. On the completion of this work the company will

have 74 miles of double-track between Cincinnati, Ohio, and Chattanooga, Tenn.

The Southern Pacific will enlarge its yards at Visitation Valley, Cal. The contemplated improvements include a new round house, car shops and about 60 miles of yard tracks. The company owns a tract of 200 acres at this point.

The Pecos & Northern Texas will build yards at Sweetwater, Okla. About six miles of track with standard terminal facilities will be put in.

The New Orleans, Mobile & Chicago has completed plans for its proposed passenger station at Mobile, Ala., to cost about $50,000.

The Chesapeake & Ohio has awarded the contract to the King Lumber Co., of Charlottesville, Va., to erect a freight depot of brick and stone, 300x50 feet in size, in that city, at an estimated cost of $50,000.

The Kansas City Southern has had surveys underway between Mount Washington and Sugar Creek, near Independence, with a view of laying a switch. The present track has a steep grade.

The St. Louis & San Francisco is to build a sea wall along the levee at Cape Gireadeau, Mo.

The Philadelphia & Reading has awarded a contract to John McMenamin, Arcade Bldg., Philadelphia, for the construction of embankments between Richmond and Somerset streets, Philadelphia, on the Richmond branch of the railroad. The price paid for this work will be about $125,000, half of which will be borne by the city and half by the company.

Contracts have been let for work on the line of the Norfolk & Western from Cedar Bluff, Va., on the Clinch Valley district, northwest to Canebrake, W. Va., on the Dry Fork branch, 15.5 miles, as follows: Rinehart & Dennis, 2.35 miles; Walton & Co., 2.6 miles; P. J. Millett, 2.9 miles; A. M. Valz, 1.76 miles, and W. O. Lipscomb, 1.84 miles, a total of 11.45 miles, to cost about $1,800,000. Work is already under way on the remaining four miles. Contracts are also let for construction of the North Fork branch of the Tug Fork branch on two miles to the Vaughan Construction Co., and on 2.3 miles to Carpenter & Boxley, a total of 4.3 miles, to cost $380,000.

Plans have been filed for a branch of the Canadian Northern from Springfield, Man., north to East Selkirk, 11.4 miles.

Double-tracking work on the Canadian Pacific from Winnipeg, Man., west to Portage la Prairie, 55 miles, has been finished, and was turned over to the operating department on October 3. Plans have been made, to start work on a line from Pincher creek, Alberta, to the mines of the Western Coal & Coke Co. at Beaver Creek. The line will probably be further extended to other coal and timber fields.

Work is now under way on the Fort Worth & Rio Grande by the C. H. Sharp Contracting Co., Kansas City, Mo., on a branch from Brady, Tex., southwest to Menardville, 40 miles. Track has been laid on 12 miles. The line will carry live stock, cotton and merchandise.

Surveys have been completed between Indianapolis, Ind., and St. Louis, Mo., for improvements to be made on the Vandalia, to include straightening the track, eliminating grades and constructing 25 miles of double-track between Effingham, Ill., and East St. Louis. The largest piece of work will be cutting down the big hill at Greenup. An entirely new right-of-way will be used.

The new station of the Hudson & Manhattan at Broadway and 33rd street, in the borough of Manhattan, New York city, will have five entrances from the street, one on the northwest corner of Broadway and 32nd street, three under the elevated stairs and one through the Gimbel store property. There are 12 staircases leading from the Concourse to the track platforms below.

The Southern Pacific is building a new power plant at the West Oakland yards for use in connection with the proposed electrification of the Oakland and Alameda line.

The Railroad Commission of Maine has issued a certificate of necessity to the Maine Central for taking land needed to carry out improvement at Bangor, Me. The company proposes to enlarge the upper part of the yard alongside the main line to Bangor and the branch line to Skowhegan.

The Pennsylvania has secured property south of Polk street, between Stewart avenue and the Chicago river, Chicago, for an extension of the company's freight terminal. The reported price paid for the site is $1,800,000.

A contract has been given to the Detroit Bridge & Steel Co. for putting up a steel and concrete bridge to be 315 ft. long over the Michigan Central tracks at 14th street in Detroit. The improvements will cost $32,275.

The Chicago & Northwestern is making good progress with the construction of its new cutoff between Milwaukee and Minneapolis and St. Paul, which will be practically a new line. It consists of two new links, one from Sparta to Wyville, a distance of 23 miles, and another from a few miles north of Milwaukee to Wyville, 141 miles. The grading of this division has been almost completed. The link between Sparta and Wyville will give a through line from La Crosse to Necedas. By using the new cutoff, together with the present trackage across the state, a much shorter route will be made from Milwaukee to the Twin Cities. A total of 177 miles of new line will be constructed and 224 miles of track will be reballasted and relaid. The branch between Milwaukee and Wyville is being built by the subsidiary concern of the Northwestern, known as the Milwaukee, Sparta & Northwestern Ry. Co., and will cost over $1,000,0000. A large sum also will be expended for new terminals at the Milwaukee end of the line.

The Arkansas, Oklahoma & Western, M. Hays, chief engineer, Rogers, Ark., will soon complete its line from Rogers to Huntsville, after which the directors will take definite steps for extending the line to Little Rock.

The promoters of the new railroad through Plateau Canon into the Plateau Valley are reported to have sold enough bonds to go ahead with the construction of the road. It is said that the grading of the road bed will be carried on at least as far as Atwell Bridge, this side of Mesa this fall and winter. J. J. Yeckel, Grand Junction, Colo., is the promoter.

The Pelham & Havana, A. C. Felton, Jr., president, Cairo, Ga., has begun grading on the extension of the line from Calvary towards Havana, Fla.

The Chicago & Northwestern is now securing right of way in St. Charles and Elgin townships for the proposed double tracking of its line from Elgin to Lake Geneva.

The Santa Fe has appropriated $8,000 to be used for the rearrangement of tracks at Coffeyville, Kan.

Every fall there are numerous destructive fires in the forests of the Northwest. The indications were that these fires will be of unusual number and destructiveness this year, because it was so dry in the months of June, July and August. For the better protection of its own property, as well as that of persons living adjacent to its lines, the Chicago & North Western has adopted on its Ashland division the use of a rather novel emergency fire fighting equipment, which has been described by the state fire inspector of Wisconsin as "A most interesting development in railway fire protection and one to be most highly recommended." The equipment consists of three tank cars and a steam pump with an ample supply of 2½-in. fire hose. The tank cars have a capacity of 24,000 gal. They are connected by 3-in. hose and stand ready filled to be hurried to any point on the division. An engine stands in the roundhouse fired up and ready to couple on to the equipment, and besides furnishing motive power for pulling the tank cars it supplies steam to operate the pump. A suction hose forms part of the equipment, so that water may be taken from any river, pond or tank.

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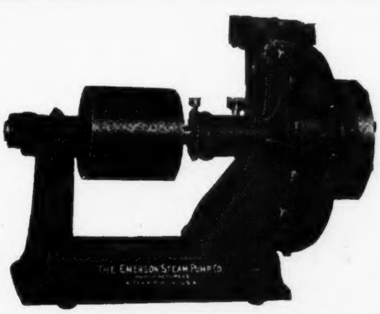

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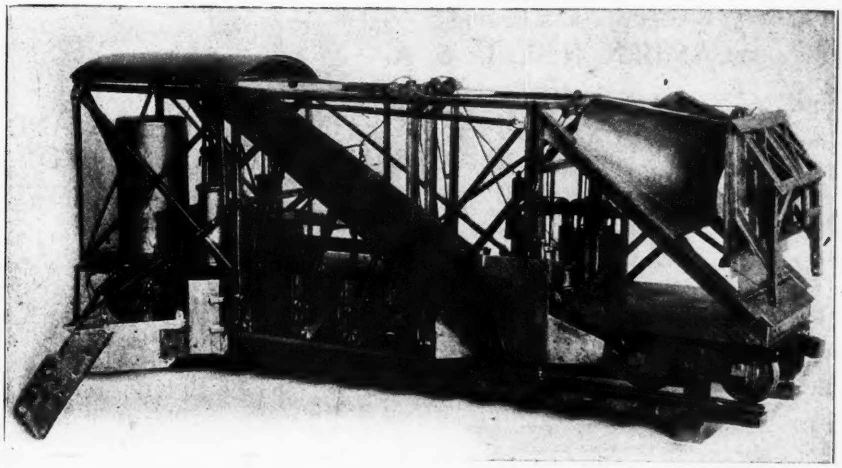

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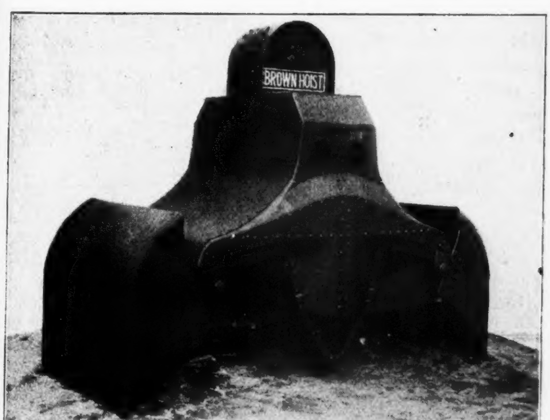

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